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COMPUTER PROGRAM (OPTCOMP) FOR OPTIMIZATION OF COMPOSITE STRUCTURES FOR MINIMUM WEIGHT DESIGN

ANALYSIS & OPTIMIZATION BRANCH
STRUCTURAL MECHANICS DIVISION

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This technical report has been reviewed and is approved for publication.

RICHARD D. KROBUSEK, Maj, USAF
Chief, Analysis & Optimization Branch
Structural Mechanics Division
AF Flight Dynamics Laboratory

FOR THE COMMANDER:

HOWARD L. FARMER, Col, USAF
Chief, Structural Mechanics Division
AF Flight Dynamics Laboratory

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The computer program OPTCOMP can be used to optimize or analyze a composite structure. The program uses an iterative procedure based on optimality criteria to design a minimum weight structure. The response of the structure to the applied loads is obtained by finite element analysis. The design variables are modified during each iteration by using a recurrence relation. The four strength criteria included in the program are maximum stress, maximum strain, Hill's criteria modified by Tsai and Norris criteria. The plate elements can be designed to prevent local buckling. The elements can be linked to have the same → next page

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sizes if desired. A mixture of composite and metal structure can be designed by suitable definition of material properties.

FOREWORD

This report is prepared as a part of in-house effort under Project 1467, "Structural Analysis Methods", Task No. 146702, "Structural Analysis Methods for Aerospace Vehicles", and Work Unit 14670246, "Automated Design of Advanced Aerospace Structures". The work was carried out in the Design and Analysis Methods Group of the Analysis and Optimization Branch (FBR), Structural Mechanics Division, Air Force Flight Dynamics Laboratory (AFFDL), Wright-Patterson AFB, Ohio. The time period of the effort was June 1973 - October 1976.

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INTRODUCTION

Advanced fiber reinforced composites such as boron-epoxy, graphite-epoxy, etc. are being used increasingly in flight vehicle structures. In order to make the most efficient use of these composites, it is necessary to have a reliable design procedure. In References 1 and 2, an optimization method was presented for the minimum weight design of composite structures with stress and displacement constraints. The concepts developed in these two references for the stress constraint design form the basis of a computer program to Optimize Composite (OPTCOMP) structures discussed in this report.

The OPTCOMP program can be used to design a minimum weight structure or to analyze a given structure which is idealized with finite elements. This is an experimental program and as such it includes different recurrence relations and strength criteria for experimentation. A metal structure or a combination of metal and composite structure can be designed by proper definition of the elastic properties of the elements.

The basic relations of the finite element method, the optimality criteria, the recurrence relations and the various strength criteria are discussed in Section II. The buckling equations and the transformations for the elastic constant matrix are also given in Section II. Section III contains a general description of the computer program. The input and output instructions are included in Sections IV and V. Section VI discusses the sample problem. The Fortran listing of the program and the output of the sample problem are presented in an Appendix.

SECTION II

ANALYTICAL FORMULATION

The optimization of a structure is an iterative procedure. The two main steps involved in the algorithm are 1) to analyze the structure to determine the response of the structure to the applied loads and 2) to modify the design variables by using a recurrence relation. These two steps are repeated for a specific number of iterations. The recurrence relations used to modify the design variables are based on the selected optimality criteria. The optimality criteria used to derive the recurrence relation may be theoretical or intuitive. In the OPTCOMP program, the response of the structure is obtained by a finite element analysis of the structure. The geometry of the structure is fixed. Hence, the design variables are the thicknesses of the homogeneous plate elements, the thicknesses of the layers in the composite elements, and the cross-sectional areas of the bars. As used throughout this report, the word "layer" identifies the total quantity of all the plies or laminae which are oriented in a specified direction within a composite laminate. Since out-of-plane bending effects are not considered in this program, the concept of layers may be applied. However, in actual laminates, these plies will be dispersed throughout the thickness. In the composite elements, the fiber directions to be used are specified.

1. Equations of Analysis

Since the finite element method of analysis is used in OPTCOMP, the basic equations are given here for ready reference. In this method the structure is discretized into a group of elements. Let the number

of elements in the structure be m and the number of layers in the composite elements be n. The force displacement relation for the whole structure is given by

$$[K]\ \{r\} = \{R\} \tag{1}$$

where [K] is the stiffness matrix of the structure, {r} is the displacement vector and {R} is the force vector. The force displacement relation for the jth layer of the ith element is given by

$$[k]_{ij}\ \{r\}_i = \{f\}_{ij} \tag{2}$$

where $[k]_{ij}$ is the stiffness matrix of the jth layer of the ith element, $\{r\}_i$ are the ith element nodal displacements and $\{f\}_{ij}$ are the nodal forces of the jth layer of the ith element. The strain energy e_{ij} of the jth layer of the ith element is given by

$$e_{ij} = \{r\}_i^t\ [k]_{ij}\ \{r\}_i \tag{3}$$

The element strains $\{\varepsilon\}_i$ in the ith element are given by

$$\{\varepsilon\}_i = [c]\ \{r\}_i \tag{4}$$

where [c] is the strain-displacement matrix. The stresses $\{\sigma\}_{ij}$ in the jth layer of the ith element are given by

$$\{\sigma\}_{ij} = [A]_{ij}\ \{\varepsilon\}_i \tag{5}$$

where $[A]_{ij}$ is the matrix of elastic constants of the jth layer of the ith element.

2. Strength Criteria

The state of stress in a layer of an element has to satisfy a certain specified strength criteria in order to avoid failure. There

are several strength criteria proposed by different authors (For a detailed discussion, see Reference 3.). Most of these are explicit or implicit functions of the stresses or strains and the corresponding maximum allowable stresses or strains.

For an orthotropic material, there are basically five allowables required for each layer of a plane stress problem. These are the tension and compression maximum allowables in the fiber direction and in the transverse direction, and the maximum shear allowable.

In the OPTCOMP computer program four strength criteria are included. The user of the program can select the one he prefers. The four criteria for the generalized plane stress condition are given below.

a. Maximum Stress Criteria

This criteria states that the failure of the material would occur if any one of the following conditions are not satisfied.

$$\begin{aligned} \sigma_1 &\leq \tilde{\sigma}_1 \\ \sigma_2 &\leq \tilde{\sigma}_2 \\ \sigma_{12} &\leq \tilde{\sigma}_{12} \end{aligned} \qquad (6)$$

where σ_1 and σ_2 are the stresses in the fiber direction and the one normal to it and σ_{12} is the shear stress. $\tilde{\sigma}_1$ and $\tilde{\sigma}_2$ are the maximum allowable stresses in the fiber and transverse directions, and $\tilde{\sigma}_{12}$ is the maximum allowable shear stress.

b. Maximum Strain Criteria

In this criteria strains instead of stresses are checked. The criteria can be expressed as

$$\begin{aligned} \varepsilon_1 &\leq \tilde{\varepsilon}_1 \\ \varepsilon_2 &\leq \tilde{\varepsilon}_2 \\ \varepsilon_{12} &\leq \tilde{\varepsilon}_{12} \end{aligned} \tag{7}$$

where ε_1 and ε_2 are the strains in the fiber direction and the one normal to it and ε_{12} is the shear strain. $\tilde{\varepsilon}_1$ and $\tilde{\varepsilon}_2$ are the maximum allowable strains in the fiber and transverse directions, and $\tilde{\varepsilon}_{12}$ is the maximum allowable shear strain. The layer is considered to have failed if any one of the conditions specified in Eq. 7 is not satisfied.

In the maximum stress and strain criteria the individual failure modes are independent.

c. Hill's Criteria Modified by Tsai

According to this criteria the material is assumed not to have failed if

$$\left[\left(\frac{\sigma_1}{\tilde{\sigma}_1}\right)^2 + \left(\frac{\sigma_2}{\tilde{\sigma}_2}\right)^2 - \left(\frac{\sigma_1 \sigma_2}{\tilde{\sigma}_1^2}\right) - \left(\frac{\sigma_{12}}{\tilde{\sigma}_{12}}\right)^2\right] \leq 1 \tag{8}$$

The definitions of $\tilde{\sigma}_1$, $\tilde{\sigma}_2$, etc. are the same as in the maximum stress criteria above.

d. Norris Criteria

This criteria can be written as

$$\left[\left(\frac{\sigma_1}{\tilde{\sigma}_1}\right)^2 + \left(\frac{\sigma_2}{\tilde{\sigma}_2}\right)^2 - \left(\frac{\sigma_1 \sigma_2}{\tilde{\sigma}_1 \tilde{\sigma}_2}\right) - \left(\frac{\sigma_{12}}{\tilde{\sigma}_{12}}\right)^2\right] \leq 1 \tag{9}$$

This criteria is similar to Eq. 8 except for the third term.

It should be pointed out that different versions of the above four criteria can be used by a proper choice of the allowables. For example, if the transverse stress is not to be considered critical as in the case of a fiber controlled laminate, $\tilde{\sigma}_2$ can be assigned a high value so that σ_2 will not become critical. Any special type of criteria can be easily introduced into the program by writing a new subroutine.

3. Recurrence Relations

In this section the recurrence relations incorporated in the OPTCOMP program are given. For the stress constraint problem, when the maximum allowable stress is not the same in all the elements of a structure, there is no rigorous method based on optimality criteria for designing a minimum weight structure. This is particularly true when the structure has plate elements. If the structure consists of bar elements only, the problem can be correctly solved by replacing the stress constraints by equivalent displacement constraints and treating it as a multiple displacement constraint problem (Reference 2). However, this procedure of treating stress constraints by equivalent displacement constraints is not feasible in a structure where there are elements connecting more than two nodes. The recurrence relations proposed here for resizing the elements are based on optimality criteria which are not rigorous in the mathematical sense, but they are found to give near optimum weight designs for large structures in a very efficient way. The recurrence relations included in OPTCOMP are either based on the strain energy in an element or the state of stress in an element. Those depending on the state of stress correspond to the fully stressed iterative procedure. The user of the program may select any one of them depending on his preference.

The optimality criteria for the generalized stiffness requirement can be stated as, "the optimum structure is the one in which the ratio of the average strain energy density to the mass density is the same in all elements" (Reference 2). This criteria can be written as

$$1 = \lambda \frac{\bar{e}_{ij}}{\rho_{ij}} \tag{10}$$

$$i = 1, \text{ -- } m$$

$$j = 1, \text{ -- } n$$

where λ is the Lagrangian parameter, ρ_{ij} is the mass density of the jth layer of the ith element, and $\bar{e}_{ij}$ is the strain energy density given by

$$\bar{e}_{ij} = \frac{e_{ij}}{V_{ij}} \tag{11}$$

Here V_{ij} is the volume of the element defined as

$$V_{ij} = t_{ij} \, l_i \tag{12}$$

where t_{ij} is the thickness of the jth layer of the ith element and l_i is the surface area of the ith element. The design variable t_{ij} can be written as

$$t_{ij} = \Lambda \, \alpha_{ij} \tag{13}$$

where α_{ij} is the relative thickness (normalized to the maximum thickness) of the jth layer of the ith element and Λ is the scaling parameter. For homogeneous elements in the structure $j = 1$. Introducing the scaling parameter Λ in Eq. 1 gives

$$\Lambda \, [K'] \, \{r\} = \{R\} \tag{14}$$

or

$$[K'] \, \{r'\} = \{R\} \tag{15}$$

where

$$\{r\} = \frac{1}{\Lambda} \{r'\} \tag{16}$$

In Eq. 15 $[K']$ is the stiffness matrix for the whole structure obtained by using the relative design vector α_{ij}. Introducing the scaling parameter into Eqs. 2 through 5, the relations between the actual quantities and the relative quantities at element level can be expressed

as

$$[k]_{ij} = \Lambda[k']_{ij} \tag{17}$$

$$\{r\}_i = \frac{1}{\Lambda}\{r'\}_i \tag{18}$$

$$\{\varepsilon\}_i = \frac{1}{\Lambda}\{\varepsilon'\}_i \tag{19}$$

$$\{\sigma\}_{ij} = \frac{1}{\Lambda}\{\sigma'\}_{ij} \tag{20}$$

where the primed quantities are the relative values.

Introducing Eqs. 11, 17 and 18 in Eq. 10 gives

$$1 = \frac{\lambda}{\Lambda^2} \quad \frac{\overline{e}'_{ij}}{\rho_{ij}} \tag{21}$$

where
$$\overline{e}'_{ij} = \frac{\{r'\}_i^t \, [k']_{ij} \, \{r'\}_i}{\alpha_{ij} \, l_i} \tag{22}$$

Multiplying both sides of Eq. 21 by α_{ij}^2 and taking the square root gives

$$\alpha_{ij} = B \, \alpha_{ij} \left(\frac{\overline{e}'_{ij}}{\rho_{ij}} \right)^{\frac{1}{2}} \tag{23}$$

where B is a constant. Eq. 23 can be rewritten in an iterative form as

$$\left(\alpha_{ij}\right)_{\nu+1} = B\left(\alpha_{ij}\right)_\nu \left[\frac{\overline{e}'_{ij}}{\rho_{ij}} \right]_\nu^{\frac{1}{2}} \tag{24}$$

where $\nu+1$ and ν refer to the cycles of iteration. In Eq. 24, B is a constant and generally it is not essential to evaluate it, since only the normalized relative design vector α_{ij} is used to analyze the structure. In the case of multiple loading conditions, a sum of relative strain energy densities due to all the loading conditions is used in Eq. 24.

In order to take into consideration the effect of different allowable stresses, the optimality criteria defined by Eq. 10 may be modified as

$$1 = \lambda \frac{\tilde{e}_{ij}}{\rho_{ij}} \tag{25}$$

$$i = 1, --, m$$

$$j = 1, --, n$$

where

$$\tilde{e}_{ij} = \frac{e_{ij}}{(\tilde{\sigma}_1 \tilde{\varepsilon}_1)_{ij}} \tag{26}$$

where $\tilde{\sigma}_1$ is the maximum allowable stress and $\tilde{\varepsilon}_1$ is the maximum allowable strain in the fiber direction of the jth layer of the ith element. Following the procedure similar to the one used to derive Eq. 24, the recurrence relation corresponding to the optimality criteria defined by Eq. 25 can be written as

$$\left(\alpha_{ij}\right)_{\nu+1} = B\left(\alpha_{ij}\right)_{\nu} \left[\frac{\tilde{e}'_{ij}}{\rho_{ij}}\right]_{\nu}^{\frac{1}{2}} \tag{27}$$

where

$$\tilde{e}'_{ij} = \frac{\overline{e}'_{ij}}{(\tilde{\sigma}_1 \tilde{\varepsilon}_1)_{ij}} \tag{28}$$

In Eq. 28 the prime quantities are the relative values. In the case of multiple loading conditions $\tilde{e}'_{ij}$ is calculated for each loading condition and the sum is used in Eq. 27.

The fully stressed iterative procedure is based on the intuition that a structure will have minimum weight if the stress in each member is equal to the maximum allowable stress for that member, under at least one loading condition. In this procedure the resizing of an element is done by multiplying the design variable by the ratio of the maximum actual stress to the corresponding maximum allowable stress for that member. In the case of a plate element since there will be three stresses (two normal and one shear), the effective stress ratio can be used. Hence, in the case of Hill's criteria modified by Tsai (Eq. 8) the recurrence relation can be written as

$$\left(\alpha_{ij}\right)_{\nu+1} = \left(\alpha_{ij}\right)_{\nu} \left[\sigma'_{eff}(Ht)\right]_{\nu}^{\frac{1}{2}} \tag{29}$$

where

$$\sigma'_{eff}(Ht) = \left[\left(\frac{\sigma'_1}{\tilde{\sigma}_1}\right)^2 + \left(\frac{\sigma'_2}{\tilde{\sigma}_2}\right)^2 - \left(\frac{\sigma'_1\ \sigma'_2}{\tilde{\sigma}_1^2}\right) + \left(\frac{\sigma_{12}}{\tilde{\sigma}_{12}}\right)^2\right]_{max} \tag{30}$$

Similarly, to fully stress the design with Norris criteria (Eq. 9), the recurrence relation is

$$\left(\alpha_{ij}\right)_{\nu+1} = \left(\alpha_{ij}\right)_{\nu} \left[\sigma'_{eff}(N)\right]_{\nu}^{\frac{1}{2}} \tag{31}$$

where

$$\sigma'_{eff}(N) = \left[\left(\frac{\sigma'_1}{\tilde{\sigma}_1}\right)^2 + \left(\frac{\sigma'_2}{\tilde{\sigma}_2}\right)^2 - \left(\frac{\sigma'_1\ \sigma'_2}{\tilde{\sigma}_1\ \tilde{\sigma}_2}\right) + \left(\frac{\sigma_{12}}{\tilde{\sigma}_{12}}\right)^2\right]_{max} \tag{32}$$

In using the recurrence relation to resize a bar element or a shear panel, only the appropriate component of the stress vector is used.

4. Buckling Equations

The equations used to modify the layer thickness of a plate element to prevent local buckling are given in this section (Reference 4). For a simply supported orthotropic plate where the length to width ratio is large (>>1),

$$N_{xcr} = K_x \frac{\pi^2 D_{11}}{w^2} \tag{33}$$

and

$$N_{xycr} = K_{xy} \frac{\pi^2 D_{11}}{w^2} \tag{34}$$

where N_{xcr} and N_{xycr} are the critical compressive load (parallel to 0° fiber) and critical shear load respectively. In Eqs. 33 and 34,

$$K_x = 2\sqrt{\beta} + \alpha \tag{35}$$

and

$$K_{xy} = \left(3.293 + \frac{2.047}{\tilde{\theta}}\right) \beta^{3/4} \quad \text{for } \tilde{\theta} \geq 1 \tag{36}$$

$$K_{xy} = (4.742 + 0.216\,\tilde{\theta} + 0.380\,\tilde{\theta}^2) \left(\frac{\alpha\beta}{2}\right)^{1/2} \quad \text{for } \tilde{\theta} < 1 \tag{37}$$

where

$$\alpha = \frac{2(D_{12} + 2D_{66})}{D_{11}} \tag{38}$$

$$\beta = \frac{D_{22}}{D_{11}} \tag{39}$$

$$\tilde{\theta} = \frac{2\beta^{\frac{1}{2}}}{\alpha} \tag{40}$$

In Eqs. 33 and 34, w is the effective width of the plate and D_{11}, D_{12}, etc. are the elements of the bending stiffness matrix. When the plate is subjected to combined compressive and shear load, the stability criterion is

$$\frac{n_x}{N_{xcr}} + \left(\frac{n_{xy}}{N_{xycr}}\right)^2 \leq 1 \tag{41}$$

where n_x and n_{xy} are the actual compressive and shear force per unit length applied to the laminate. If the elastic properties are smeared one can assume that

$$D_{ij} = \frac{A_{ij}\ t^3}{12} \tag{42}$$

where t is the total thickness of the plate. Substituting Eq. 42 in Eqs. 33 and 34 gives

$$N_{xcr} = \overline{K}_x\ t^3 \tag{43}$$

and

$$N_{xycr} = \overline{K}_{xy}\ t^3 \tag{44}$$

where

$$\overline{K}_x = \frac{K_x\ \pi^2\ A_{11}}{12\ w^2} \tag{45}$$

and

$$\overline{K}_{xy} = \frac{K_{xy}\ \pi^2\ A_{11}}{12\ w^2} \tag{46}$$

Substituting Eqs. 43 and 44 in Eq. 41 gives

$$\frac{n_x}{\overline{K}_X\, t^3} + \left(\frac{n_{xy}}{\overline{K}_{XY}\, t^3}\right)^2 \leq 1 \tag{47}$$

Hence, knowing n_x, n_{xy}, $\overline{K}_X$, and $\overline{K}_{XY}$, Eq. 47 can be solved for t to satisfy the stability criteria in the equality sense. In the OPTCOMP program during each iteration in the second stage, the required 't' is evaluated and the thickness of each layer is increased proportional to the specified fractions. The influence of boundary conditions can be taken into consideration by specifying the proper value of the width, w, of the plate.

5. Transformations

In this section the transformations used to define the fiber direction and the elastic constants in the local coordinate system are given. The fiber direction for 0° fibers can be defined in OPTCOMP either by giving the angle θ as shown in Figure 1(a) separately for each element or by specifying the projection of the 0° fibers on a defined plane (Figure 1(b)). If the latter is used, the projected direction will be the same for all 0° fibers in all the elements. In Figure 1(a) ($\overline{e}_1$, $\overline{e}_2$, $\overline{e}_n$) is the local coordinate system used to define the position of the quadrilateral ABCD. Let $\overline{AF}$ be the unit vector parallel to the 0° fibers in the element. On the plane PQRS in Figure 1(b), $\overline{A_1F_1}$ is the projection of $\overline{AF}$. The plane PQRS is defined by $\overline{A_1F_1}$ and $\overline{A_1G_1}$ which are perpendicular to each other. $\overline{n}$ is the normal vector of unit length to the plane PQRS.

Consider a plane passing through the vectors $\overline{A_1F_1}$, $\overline{n}$ and $\overline{AF}$. (See Figure 1(c)). Then

$$\overline{A_1F_1} + \overline{F_1F} = \overline{A_1F} = \overline{AF} \tag{48}$$

and

$$\overline{F_1F} = H\,\overline{n} \tag{49}$$

where H is a scalar quantity. The relation given in Eq. 49 is correct since the unit vector $\overline{n}$ is parallel to $\overline{F_1F}$. Taking the scalar product of Eq. 48 with $\overline{e_n}$ and using Eq. 49, one can write

$$H = -\frac{\overline{e_n} \cdot \overline{A_1F_1}}{\overline{e_n} \cdot \overline{n}} \tag{50}$$

Thus, knowing the direction of the projected vector $\overline{A_1F_1}$, Eqs. 48 through 50 can be used to define the vector $\overline{AF}$. In the input data of the OPTCOMP program the vectors $\overline{A_1F_1}$ and $\overline{A_1G_1}$ are defined by giving the coordinates of points A_1, F_1 and G_1.

In Figure 2, $(\overline{e_1}, \overline{e_2}, \overline{e_n})$ is the local coordinate system of the element. The unit vector parallel to the fiber direction is $\overline{e_f}$. $\overline{e_g}$ is perpendicular to $\overline{e_f}$ such that $\overline{e_n} = \overline{e_f} \times \overline{e_g}$. The two coordinate systems are related by

$$\begin{aligned} \overline{e_f} &= \ell_{11}\,\overline{e_1} + \ell_{12}\,\overline{e_2} \\ \overline{e_g} &= \ell_{21}\,\overline{e_1} + \ell_{22}\,\overline{e_2} \end{aligned} \tag{51}$$

where ℓ_{11}, ℓ_{12}, etc. are the direction cosines. Let $\{\sigma\}$ and $\{\varepsilon\}$ be the stresses and strains in the local coordinate system, and $\{\bar{\sigma}\}$ and $\{\bar{\varepsilon}\}$ be the same quantities in the fiber coordinate system $(\bar{e}_f, \bar{e}_g, \bar{e}_n)$. The stresses and the strains in the two coordinate systems are related by

$$\{\bar{\sigma}\} = [L_1]\,\{\sigma\} \tag{52}$$

$$\{\bar{\varepsilon}\} = [L_2]\,\{\varepsilon\} \tag{53}$$

where

$$[L_1] = \begin{bmatrix} \ell_{11}^2 & \ell_{12}^2 & 2\ell_{11}\,\ell_{12} \\ \ell_{21}^2 & \ell_{22}^2 & 2\ell_{22}\,\ell_{21} \\ \ell_{11}\,\ell_{21} & \ell_{12}\,\ell_{22} & \ell_{12}\,\ell_{21} + \ell_{11}\,\ell_{22} \end{bmatrix} \tag{54}$$

and

$$[L_2] = \begin{bmatrix} \ell_{11}^2 & \ell_{12}^2 & \ell_{11}\,\ell_{12} \\ \ell_{21}^2 & \ell_{22}^2 & \ell_{22}\,\ell_{21} \\ 2\ell_{11}\,\ell_{21} & 2\ell_{12}\,\ell_{22} & \ell_{12}\,\ell_{21} + \ell_{11}\,\ell_{22} \end{bmatrix} \tag{55}$$

It is of interest to note that

$$[L_1]^{-1} = [L_2]^t \tag{56}$$

and

$$[L_2]^{-1} = [L_1]^t \tag{57}$$

The stress-strain relations are given by

$$\{\sigma\} = [A]\,\{\varepsilon\} \tag{58}$$

and

$$\{\bar{\sigma}\} = [\bar{A}]\ \{\bar{\varepsilon}\} \tag{59}$$

where [A] and $[\bar{A}]$ are the elastic constant matrices in the two coordinate systems. Using Eqs. 52 and 53, Eq. 59 can be written as

$$[L_1]\ \{\sigma\} = [\bar{A}]\ [L_2]\ \{\varepsilon\} \tag{60}$$

Multiplying both sides of Eq. 60 by $[L_1]^{-1}$ gives

$$\{\sigma\} = [L_1]^{-1}\ [\bar{A}]\ [L_2]\ \{\varepsilon\} \tag{61}$$

or

$$\{\sigma\} = [L_2]^t\ [\bar{A}]\ [L_2]\ \{\varepsilon\} \tag{62}$$

Comparing Eqs. 58 and 62 we can write

$$[A] = [L_2]^t\ [\bar{A}]\ [L_2] \tag{63}$$

Eq. 63 can be used to transform the elastic constant matrix from one coordinate system to the other.

SECTION III

DESCRIPTION OF THE PROGRAM

The flow diagram showing the basic steps of the optimization procedure used in OPTCOMP is given in Figure 3. In the first stage, the structure is optimized to satisfy the stress constraints alone. The design at the end of this stage will have minimum weight, and it will satisfy the strength criteria in all the elements. In the second stage, the plate elements which are critical in buckling are increased in thickness to prevent local buckling. At the end of the second stage, all elements will satisfy the strength criteria and no plate elements will fail due to local buckling. The initial thicknesses of the elements for optimization can be included in the input data or the program will assign 0.1-inch thickness for plate elements with equal percentage of laminas in all fiber directions, and 1.0 square inch cross-sectional area for bar elements.

The four types of elements included in the program are: 1) a constant strain triangle, 2) a quadrilateral constructed from four constant strain triangles, 3) a shear panel, and 4) a bar. The sequence of node numbers used to define the elements is given in Figure 4. The triangle and the quadrilateral may be layered composite elements. In defining the material axis, either the direction of the 0° fiber orientation is specified by angle θ (Figure 1(a)) defined by the variable ZANGLE in the input Card Set 11 for each element, or the projection of the 0° fibers is given on a certain plane (See Figure 1(b)). This projection will be the same for all the elements. The projection and the plane is defined by the coordinates of the three points in the input Card Set 9. The fiber

directions in other layers are given in the input Card Set 10, with respect to the 0° direction. The material properties are given for all layers in an element as a set, which is designated by one material number. For example, an element with all layers of graphite epoxy may be assigned material number 1, an element with one layer of boron-epoxy and the remaining layers of graphite epoxy may be assigned material number 2, and an element with two layers of graphite-epoxy and the remaining layers of glass-epoxy may be assigned material number 3. If there are any metal elements with isotropic properties they can be assigned yet a different material number. The total number of materials to be used for quadrilaterals and triangles is defined by the variable NMAT2 in the input Card Set 3, and the elastic properties, thickness of lamina, minimum number of lamina in each layer are read in the input Card Set 7. In the case of shear panels and bar elements the number of materials used is defined by NMAT1 in Card Set 3 and the elastic properties and the maximum allowable stresses are read in Card Set 6. It should be pointed out here that the material numbers assigned for the quadrilaterals and the triangles may be the same as the one used for the shear panels and bars, but their meanings are different for the two cases.

The program has provision for four widely used strength criteria for composite structures. These are: 1) maximum allowable stress, 2) maximum allowable strain, 3) Hill's criteria modified by Tsai, and 4) Norris criteria. These criteria are given in Section II(2). The user can select any one of these criteria depending on his preference by specifying the proper number for NCRTIA in the input Card Set 3, and

for NEF in the input Card Set 4. All these criteria are functions of the maximum normal allowable stress or strain in the fiber direction and in the transverse direction, and the maximum shear allowable. The maximum normal allowable stresses may have different magnitudes depending on whether they are tensile or compressive stresses. As such the total number of maximum allowable stresses specified is five. In case the user wants to relax the restriction on any of these allowables, he can specify a very high value. Selection of these allowables is very important since the weight of the structure is directly proportional to the scaling parameter which is determined on the basis of satisfying the strength criteria for each element. This data is included in the input Card Set 8 for each layer of the material set.

There are four recurrence relations included in the program (See Section II(3)). Two relations are based on the strain energy density in an element and the remaining are based on the state of stress. The user may select any one of these by assigning the proper value to NENG in the input Card Set 3. If the user is not familiar with the implications of using the different recurrence relations, it is recommended that he use NENG = 1. This will produce good results for a general structure.

In the input Card Set 3, LSTCCL designates the total number of iterations for the stress constraint design. Out of this total, for LLSTCL iterations, the design variables are modified by using the recurrence relation. In the remaining iterations, the thickness of each element is modified to make the scaling parameter Λ (See Eqs. 13, 19, 20) nearly the same for all the elements. During this second phase of optimization, the percentage of laminas in the different fiber directions in the composite

elements remains unchanged. This process of equalizing the scaling parameter sometimes reduces the weight of the structure depending upon the type of structure, the variation in the magnitude of the different maximum allowables, and the selected strength criteria. At the end of LSTCCL iterations, the details of the minimum weight design are printed out. In the second stage for LNSB iterations, the thicknesses of the quadrilateral and triangular elements are modified to prevent local buckling of the panels (See Section II(4)). These equations are based on the approximation of smeared orthotropic properties. The effect of boundary conditions can be taken into consideration by specifying the proper value of the effective width of the plate (AWIDE(I), BWIDE(I) in the input Card Set 11). It should be noted that the effective width is not the width of the element, but the distance between the supports multiplied by the proper fraction to account for boundary conditions other than simply supported. The user has the option to indicate which layer thicknesses to increase and in what proportion to satisfy the stability criteria. This is achieved by giving proper values to PECT in the input Card Set 5. In the case of a 0°, 90°, ± 45° laminate, it has been found that it is more beneficial to increase the ± 45° layers than to increase the thickness of the whole laminate. The initial design for the second stage of optimization is the minimum weight design obtained in the first stage. In the second stage, since the thicknesses of the elements are increased, the weight of the structure goes up with each additional iteration. When all the plate elements satisfy the stability criteria, the weight of the structure stabilizes. It has been found that about five to six iterations are generally sufficient to reach the stable conditions.

The program has a provision for specifying the minimum and maximum thickness of each element by specifying the proper values of BMIN and BMAX in the input Card Sets 11 and 12. The minimum number of laminae in a layer is defined by THMIN in the input Card Set 7. The elements can be linked to have the same sizes by defining the number of sets and the element numbers in each set in the input Card Sets 13 and 14.

When the structure is to be analyzed only, set LSTCCL = 0 in the input Card Set 3. The elements which violate the specified criteria can be separated by assigning LCHEK = 1 in the input Card Set 4. This control will print out all the elements which violate the strength criteria and also the ratio of the actual stress to the maximum allowable stress for those elements. If the specified criteria is the maximum strain criteria, it will be the ratio of strains and for the Hill and Norris criteria, the effective stress ratio.

In the output the user has the option to print the stresses in the local element coordinate or the fiber coordinate system in a layer (See Figure 2), the strains in the fiber coordinate system, the effective stress ratios in each layer as defined by the Hill or Norris criteria, the average stresses in the 0° fiber coordinate system, and the nodal forces in the local or global coordinate system. The control parameters for this data are defined in the input Card Set 4. The reactions at the boundaries and the sum of the forces and moments about the three coordinate axes through the origin are printed at the end. This information is generally useful for an equilibrium check.

The program listed in the report is limited to solving problems with a maximum value of the different variables as given below

Number of members - MEMBS - 120

Number of quadrilaterals and triangles - NC - 50

Number of shear panels and posts - NI - 70

Number of nodes - JOINTS - 50

Number of boundaries - NB - 50

Number of loading conditions - LOADS - 2

Number of layers in the composite elements - NZ - 4

Number of sets of the materials for shear panels and bars - NMAT1 - 4

Number of different materials used for quadrilaterals and triangles - NMAT2 - 4

Number of elements in the stiffness matrix - NMAX - 5000

Number of sets of linked elements - LNK - 5

Number of elements in each linked sets - LMAX - 10

Core required on the Cyber-7400 - NOS/BE operating system - 114_8K

On the Cyber-7400 a much larger problem can be solved by increasing the dimensions of the different variables as indicated by the comments in the program.

A short description of the subroutines used in the program is given below.

Program MAIN

The MAIN program reads the input data, generates the stiffness matrix of the whole structure and determines the displacement vector. It then uses the information received from the MEMB subroutine to calculate the weight of the structure and to modify the design variables by using the recurrence relations. At the end it prints out the number of laminas in the layered elements, the cross-sectional areas of the bar elements and the thicknesses of the remaining elements.

SUBROUTINE MEMB

This subroutine is the longest subroutine and is called twice from the MAIN program. It calculates the stresses, strains, and strain energies in all the elements. The scaling parameter Λ used to satisfy the strength criteria in all the elements is determined in this subroutine. The membrane elements which are susceptible to local buckling are modified here. The stresses, strains, nodal forces, etc. are printed out by this subroutine after the last iteration.

The following subroutines are called by MAIN and MEMB to carry out various calculations.

SUBROUTINE SUGD

This subroutine calculates the scaling parameter for the membrane element to satisfy the maximum stress criteria or the maximum strain criteria.

SUBROUTINE AVECT

This subroutine defines the direction of the fibers in the layer of a membrane element by a set of components in the local coordinate system of the element.

SUBROUTINE SURFACE

This subroutine calculates the scaling parameter for a shear panel and a bar element to satisfy the maximum allowable stress.

SUBROUTINE COORD

This subroutine establishes the local coordinate system of the elements. It also determines the transformation matrices needed to transform the stiffness matrix and the displacement vector from one coordinate system to another.

SUBROUTINE ELAS

This subroutine determines the elastic matrix of the layer in the membrane element in the local coordinate system. It also calculates the transformation matrix to get the stresses and strains in the fiber coordinate system from the local coordinate system.

SUBROUTINE STRAIN

This subroutine evaluates the strains in a membrane element from the nodal displacements in the local coordinate system.

SUBROUTINE COMP

This subroutine calculates the stiffness matrix of a triangular membrane element in the local coordinate system.

SUBROUTINE ELSTIF

This subroutine determines the stiffness matrix of a bar element in the local and the global coordinate system.

SUBROUTINE ASEMBL

This subroutine assembles the stiffness matrix for the whole structure in the global coordinate system.

SUBROUTINE CONDNS

This subroutine eliminates the internal dummy node point of the quadrilateral and condenses the stiffness matrix from (10x10) to (8x8).

SUBROUTINE SUM

This subroutine assembles the stiffness matrix (10x10) of the quadrilateral from the stiffness matrices of the four triangles.

SUBROUTINE CHANGE

This subroutine which is called from the CONDNS subroutine rearranges the stiffness matrix of the quadrilateral and the shear panel.

SUBROUTINE TRNSF

This subroutine is used to transform the stiffness matrix from the local coordinate system to the global coordinate system.

SUBROUTINE POP

This subroutine determines the exact core required to store the stiffness matrix of the whole structure. It also defines the location of the elements on the main diagonal and the first nonzero element of each row.

SUBROUTINE GAUSS

This subroutine solves the linear algebraic equations and determines the displacement vector.

SUBROUTINE BOUND

This subroutine eliminates the rows and columns corresponding to the boundary conditions from the stiffness matrix of the whole structure.

SUBROUTINE PRNTDR

This subroutine is called to print out the node numbers, coordinates, forces, and the displacements.

SUBROUTINE REDUCE

This subroutine eliminates the rows from the force matrix corresponding to the boundary conditions.

SUBROUTINE RESTOR

This subroutine restores the boundary conditions in the force and the displacement matrices.

SUBROUTINE ELSTRS

This subroutine determines the stress and the strain energy in a bar element.

SUBROUTINE SCOMP

This subroutine computes the stiffness matrix of a shear panel.

SUBROUTINE SSRS

This subroutine determines the stress and the strain energy in a shear panel.

SUBROUTINE BFORCE

This subroutine calculates the average stress on the the membrane element.

SUBROUTINE SBUCKL

This subroutine determines the increase in thickness of the membrane element needed to prevent local buckling of the plate.

SUBROUTINE ANORM

This subroutine normalizes the relative design vector.

SUBROUTINE MULT

This subroutine is used to multiply the stiffness matrix and the displacement matrix to determine the applied forces and the reactions at the supports.

SUBROUTINE ENGS

This subroutine determines the strain energy in a layer of a membrane element.

SUBROUTINE STRESS

This subroutine determines the stresses in the local coordinate system and the material coordinate system and the strains in a membrane element.

SUBROUTINE SHILL

This subroutine determines the scaling parameter in a membrane element for the strength criteria of Hill or Norris.

SUBROUTINE AVG

This subroutine determines the average stresses for a quadrilateral from the stresses in the four triangles.

SUBROUTINE AEQ

The sum of all the external forces and the moments about the three axes passing through the origin are calculated in this subroutine to check the overall equilibrium.

SUBROUTINE ALINK

This subroutine calculates the average strain energy density for all the elements which are specified to have the same thickness for linking of variables.

SECTION IV

PROGRAM INPUT INSTRUCTIONS

This section describes the input data required for optimization of a structure.

Card Set 1 PROBLEMS (I5)

Col	1-5	NSTAR	Number of problems

Note: Subsequent set of cards are repeated depending on the number of problems to be solved.

Card Set 2 HEADING (8A10)

Col	1-80	HED	An alphanumeric description of the problem to be solved.

Card Set 3 GENERAL PROBLEM RELATED DATA (16I5)

Col	1-5	MEMBS	Number of elements
	6-10	NC	Number of membrane elements (quadrilaterals and triangles)
	11-15	NI	Number of shear panels and posts (bar elements)
	16-20	JOINTS	Number of nodes
	21-25	NB	Number of restrained degrees of freedom
	26-30	LOADS	Number of loading conditions
	31-35	MM	Number of degrees of freedom per node

$$MM = \begin{cases} 2 - \text{two-dimensional problem} \\ 3 - \text{three-dimensional problem} \end{cases}$$

	36-40	NZ	Number of layers in the membrane elements. Each layer corresponds to a fiber orientation.

41-45	INCHES	Control for units of distance

INCHES = 1 - for inches; 0 - for feet

46-50	KIPS	Control for the units of the applied forces

KIPS = 1 - for kips; 0 - for pounds

51-55	NMAT1	Number of different sets of materials used for shear panels and bars (See Section III)
56-60	NMAT2	Number of different materials used for membrane elements (See Section III)
61-65	NFIBER	Control for the definition of 0° fibers

NFIBER = 0 - Projection specified; 1 - Angle θ is specified for each element

66-70	NCRTIA	Control for the strength criteria

NCRTIA =
1 - Maximum stress (See Eq. 6)
2 - Maximum strain (See Eq. 7)
3 - Hill(See Eq. 8)(NEF in Card Set 4 must be 1)
4 - Norris(See Eq. 9)(NEF in Card Set 4 must be 2)

71-75	NENG		Control for the recurrence relation
		NENG =	1 - Strain energy density (See Eq. 24) 2 - Ratio of strain energy to maximum strain energy density (See Eq. 27) 3 - Effective stress ratio (See Eq. 29) NCRTIA must be 3 4 - Effective stress ratio (See Eq. 31) NCRTIA must be 4
76-80	LINK		Control for linkage of elements (See Section III)
		LINK =	0 - No linkage 1 - linkage
1-5	MCONST		Control for specified sizes for a set of elements
		MCONST =	0 - Small number of specified sizes (less than 20% of the total number of elements) 1 - Large number of specified sizes
6-10	NSTART		Control to read the element sizes for the initial design
		NSTART =	0 - Not specified 1 - Specified
11-15	LSTCCL		Number of iterations for the stress constraint design. If LSTCCL = 0 the given structure is to be analyzed only.

16-20	LLSTCL	Number of iterations to modify the design variables by using the recurrence relation (See Section III) LLSTCL < LSTCCL
21-25	LNSB	Number of iterations for modification of the membrane elements to avoid local buckling (See Section III).
26-30	NBLNCE	Control to equalize the thickness of $\pm\theta$ layers (last two layers).

$$NBLNCE = \begin{cases} 0 - \text{Not required} \\ 1 - \text{Required} \end{cases}$$

<u>Card</u> <u>Set</u> <u>4</u> OUTPUT CONTROL (16I5)

Note: This set controls the nature of the output desired. The program will write only that information which the user asks. Most of these controls are for the stresses in the quadrilaterals and triangles.

Col		
1-5	NAREA	The relative sizes of the elements for intermediate iterations

$$NAREA = \begin{cases} 0 - \text{Not required} \\ 1 - \text{Required} \end{cases}$$

6-10	NLO	The stresses in the layers of the membrane elements in the local element coordinates.

$$NLO = \begin{cases} 0 - \text{Not required} \\ 1 - \text{Required} \end{cases}$$

11-15	NZEO	The stresses in the layers of the membrane elements in the material coordinates of the 0° layer

$$NZEO = \begin{cases} 0 - \text{Not required} \\ 1 - \text{Required} \end{cases}$$

16-20	NSTRN	The strains in the layers of the membrane elements in fiber direction NSTRN = 0 - Not required 1 - Required
21-25	NAVG	The average stresses for the laminate in the 0° fiber direction NAVG = 0 - Not required 1 - Required
26-30	NFI	The stresses in the layers of the membrane elements in the individual layer material coordinates NFI = 0 - Not required 1 - Required
31-35	NEF	The effective stresses in the layers of membrane elements NEF = 0 - Not Required 1 - Required (See Eq. 8) 2 - Required (See Eq. 9)
36-40	NFOR	The nodal forces in the elements NFOR = 0 - Not required 1 - Required (local element coordinates) 2 - Required (global coordinates)

41-45	LCHEK	Identification of the elements which do not satisfy the strength criteria, when the structure is to be analyzed only (LSTCCL = 0).

$$\text{LCHEK} = \begin{cases} 0 - \text{Not required} \\ 1 - \text{Required} \end{cases}$$

Card Set 5 DATA TO PREVENT MEMBRANE ELEMENTS FROM LOCAL BUCKLING (8E10.4)

Note: Card set 5 is needed only if LNSB defined in card set 3 is not equal to zero.

PECT(I) I = 1,...NZ	Fractions to control the increase in thickness of each layer to prevent local buckling (See Section III)

$$\sum_{I=1}^{NZ} \text{PECT}(I) = 1.$$

Card Set 6 MATERIAL PROPERTY DATA FOR SHEAR PANELS AND BARS (4F20.4)

Note: Units of the allowable stresses in this set should be consistent with that of the loads. There will be two cards for each value of I. I is the material property number.

Col		
1-20	E(I)	Elastic modulus in psi/10^6 for the Ith material
21-40	PMU(I)	Poisson's ratio for the Ith material
41-60	GSHE(I)	Shear modulus in psi/10^6 for shear panels for the Ith material. If this input is zero, then

$$\text{GSHE}(I) = \frac{E(I)}{2*(1+\text{PMU}(I))}$$

61-80	SSTRT(I)	Allowable stress in tension for bars for the Ith material
1-20	SSTRC(I)	Allowable stress in compression for bars for the Ith material
21-40	SSTRS(I)	Allowable stress in the shear panels for the Ith material
41-60	SPWTT(I)	Density in lbs/in^3 for the Ith material

I = 1,...,NMAT1

Card Set 7 — MATERIAL PROPERTY DATA FOR MEMBRANE ELEMENTS (8E10.4)

Note: The total number of data cards in this set is equal to NZ * NMAT2. There will be NMAT2 subset of cards. The Jth subset contains NZ cards giving the properties of each layer in sequence. J defines the material property number for the laminate.

Col		
1-10	E11(I,J)	Elastic modulus parallel to the fiber direction for the Ith layer of the Jth material in psi/10^6.
11-20	E22(I,J)	Elastic modulus transverse to the fiber direction for the Ith layer of the Jth material in psi/10^6.
21-30	ANU1(I,J)	Poisson's ratio ν_{12} for the Ith layer of the Jth material.
31-40	ANU2(I,J)	Poisson's ratio ν_{21} for the Ith layer of the Jth material. If this input is zero, then $\text{ANU2(I,J)} = \text{ANU1(I,J)}\ \frac{\text{E22(I,J)}}{\text{E11(I,J)}}$
41-50	GSH(I,J)	Shear modulus for the Ith layer of the Jth material in psi/10^6. If this input is zero, then $\text{GSH(I,J)} = \frac{\text{E11(I,J)}}{(2(1+\text{ANU1(I,J)}))}$

51-60	SPWTC(I,J)	Density in lbs/in^3 for the Ith layer of the Jth material.
61-70	THEK(I,J)	Thickness of a lamina of the Ith layer of the Jth material. This value is used to calculate the number of laminas in a layer for the final design.
71-80	THMIN(I,J)	Minimum thickness of the Ith layer of the Jth material. This value is equal to the minimum number of laminas multiplied by THEK(I,J).

I = 1,...,NZ

J = 1,...,NMAT2

<u>Card Set 8</u> ALLOWABLE STRENGTHS FOR THE MEMBRANE ELEMENTS (5F15.2)

Note: The number of cards in this set is equal to NZ * NMAT2 Thus there will be NMAT2 subset of cards. The Jth subset contains NZ cards giving the allowables of each layer in sequence. J is the material property number for the laminate. Units of the allowable stresses in this set should be consistent with that of the loads. If NCRTIA = 2 (i.e., Maximum strain criteria) this set will contain allowable strains instead of allowable stresses.

Col

1-15	SSMAX(1,K,J)	Tension allowable parallel to the fiber direction in the Kth layer of the Jth material.
16-30	SSMAX(2,K,J)	Compression allowable parallel to the fiber direction in the Kth layer of the Jth material.
31-45	SSMAX(3,K,J)	Tension allowable transverse to the fiber direction in the Kth layer of the Jth material.

46-60	SSMAX(4,K,J)	Compression allowable transverse to the fiber direction in the Kth layer of the Jth material.
61-75	SSMAX(5,K,J)	Shear allowable transverse to the fiber direction in the Kth layer of the Jth material.

K = 1,...,NZ

J = 1,...,NMAT2

Card Set 9 DATA FOR DEFINITION OF THE 0° FIBER (3E10.4)

Note: Coordinates of three points are given. This defines the plane of projection and the projection of the 0° fibers on the plane. (See Section II(5)). If MM=2, only XD(I) and YD(I) are input. If NIFBER=1 in card set 1, this card set is not read.

Col		
1-10	XD(I)	X coordinate of the Ith point.
11-20	YD(I)	Y coordinate of the Ith point.
21-30	ZD(I)	Z coordinate of the Ith point.

I = 1,...,3

Card Set 10 FIBER DIRECTION ANGLES IN LAYERS (8E10.4)

	ANGLE(I)	Angle in degrees for the NZ layers. The first angle is 0°.

I = 1,...,NZ

Card Set 11 DATA FOR MEMBRANE ELEMENTS (QUADRILATERALS OR TRIANGLES) (I5, I3, I2, 4I5, 5E10.4)

Note: There is one card for each membrane element (See Figure 4). The elements are numbered in sequence but can be arranged in any order within this card set. All membrane elements are first numbered, then shear panels and bars are numbered.

Col		
1-5	I	Element number
6-8	KTYPE(I)	Type of element
		KTYPE(I) = 3 - triangle; 4 - quadrilateral
9-10	NMAT(I)	Material property number of the element
11-15	MA(I)	First node number of the element
16-20	MB(I)	Second node number of the element
21-25	MC(I)	Third node number of the element
26-30	MD(I)	Fourth node number of the element. For a triangle MD(I) = 0
31-40	BMAX(I)	Maximum thickness allowed for the element. If there is no limit on size input a large number say 100.
41-50	BMIN(I)	Minimum thickness allowed for the element. This should be consistent with THMIN(I,J) in card set 7.

Note: AWIDE and BWIDE should be consistent with the element supports for local buckling.

51-60	AWIDE(I)	Effective width of the Ith element transverse to the 0° fibers for local buckling. N_x (compression) critical.
61-70	BWIDE(I)	Effective width of the Ith element parallel to the 0° fibers for local buckling. N_y (compression) critical.

Note: If NFIBER = 0 in card set 3, then ZANGLE(I) is zero.

71-80	ZANGLE(I)	Angle in degrees which the 0° fibers make with a line joining MA(I) and MB(I). See Fig. 1(a).

I = 1,...,NC

<u>Card Set 12</u>

DATA FOR SHEAR PANELS AND BARS
(I5, I3, I2, 4I5, 2E10.4)

Note: There is one card for each element. The element numbering is sequential but they can be arranged in any order within this card set. These elements are numbered after all the membrane elements are numbered.

Col		
1-5	I	Element number
6-8	KTYPE(I)	Type of element

$$\text{KTYPE(I)} = \begin{cases} 5 - \text{shear panel} \\ 2 - \text{bar} \end{cases}$$

9-10	NMAT(I)	Material property number of the element
11-15	MA(I)	First node number of the element
16-20	MB(I)	Second node number of the element
21-25	MC(I)	Third node number of the element. MC(I) = 0 for bar.

26-30	MD(I)	Fourth node number of the element. MD(I) = 0 for bar.
31-40	BMAX(I)	Maximum thickness allowed for the element. For a bar element BMAX(I) is the cross-sectional area. If there is no limit on size, input a large number, say 100.
41-50	BMIN(I)	Minimum thickness allowed for the element. For a bar element BMIN(I) is the cross-sectional area.

I = (NC + 1),...,MEMBS

Note: Card sets 13, 14, and 15 are read only if LINK = 1 in card set 3.

<u>Card Set 13</u> DATA FOR LINKAGE (3I5)

Col		
1-5	LNK	Total number of sets of linked elements.
6-10	NSKIN	Number of sets of linked elements amongst the membrane elements.
11-15	NINT	Number of sets of linked elements amongst the shear panels and bars.

<u>Card Set 14</u> NUMBER OF ELEMENTS LINKED PER SET (16I5)

NLINK(I) — Number of elements in each linked set.

I = 1,...,LNK

<u>Card Set 15</u> LINKED ELEMENTS (16I5)

NELEM(K,J) — Element numbers in each linked set. Each subset is started on a new card.

K = 1,...,LNK
J = 1,...,NLINK(K)

Note: Card sets 16 and 17 are read only if LSTCCL = 0 or NSTART = 1 in card set 3.

Card Set 16 THICKNESSES OF THE QUADRILATERALS AND TRIANGLES (8E10.4)

AL(I,L) I = 1,...,NC L = 1,...,NZ	Thickness of membrane elements. Each subset contains one thickness of the layer for all elements. The number of subsets is equal to the number of layers. Each subset is started on a new card.

Card Set 17 THICKNESSES OF SHEAR PANELS AND CROSS-SECTIONAL AREAS OF BARS (8E10.4)

A(I) I = (NC + 1),...,MEMBS	Thickness of shear panels and cross-sectional areas of bars.

Card Set 18 COORDINATES OF NODES (I5, 3E10.4)

Note: The node numbering must be sequential but may be arranged in any order within this card set.

Col		
1-5	I	Node number
6-15	X(I)	X coordinate of the Ith node
16-25	Y(I)	Y coordinate of the Ith node
26-35	Z(I)	Z coordinate of the Ith node

I = 1,...,JOINTS

Card Set 19 BOUNDARY CONDITIONS (16I5)

IBND(I) I = 1,...,NB	Degree of freedom numbers of those nodes which are restrained. For node k the degree of freedom numbers are 3*K-2, 3*K-1, and 3*K (X, Y and Z respectively) for MM = 3 and 2*K-1 and 2*K (X and Y respectively) for MM = 2.

Card Set 20 NUMBER OF FORCES IN EACH LOADING CONDITION (16I5)

NJLODS(I) I = 1,...,LOADS	Number of load components in the Ith loading condition.

<u>Card Set 21</u> LOCATION AND APPLIED LOADS
3(E10.4, 2I5)

Note: The number of subsets is equal to the number of loading conditions (LOADS). Each subset is started on a new card.

Col		
1-10	TFR(J)	Value of the Jth load.
11-15	IM(J)	Direction of the load
16-20	JM(J)	Number of the node where the load is applied.

$$IM(J) = \begin{cases} 1 - X \text{ direction} \\ 2 - Y \text{ direction} \\ 3 - Z \text{ direction} \end{cases}$$

J = 1,...,NJLODS(I)

SECTION V

PROGRAM OUTPUT DETAILS

This section describes the output from the program. The items are discussed in the order they appear.

1) The input data is printed out in the same format as the READ statements in the program.

2) The output from the POP subroutine concerning the distribution of elements in the stiffness matrix is printed. This information is

a) GROSS POPULATION - total number of elements in the upper triangle of the matrix.

b) APPARENT POPULATION - actual number of elements considered as non-zero by a given solution scheme. The apparent population represents the number of storage locations required for the stiffness matrix. If the apparent population is greater than NMAX, the program will write the message INSUFFICIENT CORE TO STORE STIFFNESS MATRIX, DIMENSION OF SK SHOULD BE (APPARENT POPULATION NUMBER).

c) STARTING ROW NUMBER FOR EACH COLUMN - The number of the row where the first non-zero element occurs in each column. The variable defined in the program is IC(I), I=1, NN(total degrees of freedom).

d) NUMBERS OF DIAGONAL ELEMENTS IN SINGLE ARRAY STIFFNESS MATRIX - For each column I the actual number of elements, ID(I) in the upper triangular matrix up to and including that column, i.e.,

$$ID(I) = \frac{I(I + 3)}{2} - \sum_{j=1}^{I} b_j$$

where b_j is the row number given for Column I in (c). Thus for the last column ID(LAST) = APPARENT POPULATION.

3) TIME USED IN SECONDS - Time the program has spent in execution up to that point. This item is repeated after each iteration.

4) RELATIVE AREAS OF MEMBERS - These are printed only if NAREA in the Input Card Set 4 is 1.

a) The first set includes the relative total areas of all members. For composite elements this will be the relative total thickness of all layers; for shear panels, the total thickness, and for bars, cross-sectional areas. The variable defined in the program is A(I), I = 1,...,MEMBS.

b) The remaining sets include the relative thickness of each layer in the quadrilateral and triangular elements. The variable in the program is AL(I,J), I = 1,...,NC

J = 1,...,NZ

5) WEIGHT-SKIN	-	Weight of all quadrilateral and triangular elements
WEIGHT-S-PANELS	-	Weight of all shear panels
WEIGHT-POSTS	-	Weight of all bar elements
TOTAL-WEIGHT	-	Total weight of the structure. This is the sum of above three weights.
ELE SKIN	-	Element amongst the quadrilaterals and triangles requiring the largest value of the scaling parameter to satisfy the strength criteria.
ABASE	-	Scaling parameter for the element ELE SKIN.
ELE STRUCT	-	Element amongst shear panels and bars requiring largest value of the scaling parameter to satisfy the maximum allowable stress.
CBASE	-	Scaling parameter for the element ELE STRUCT.

STRUCTURE NO - Problem number

NO OF LOADS - Number of loading conditions

CYCLE NO - Iteration number

EQ CYCLE NO - Number of iterations used to equalize the scaling parameter in the elements. (See Section III)

NSTBLTY - Number of iterations used to modify the elements critical in local buckling.

The data in item 5 is repeated after each iteration.

6) The following information is given for the minimum weight design after completing the specified number of iterations.

L = element number

BASEA = scaling parameter

L-C = critical loading condition for the element

CRI = the critical stress in that element

1 - stress in fiber direction
2 - stress in transverse direction
3 - shear stress

In the case of the maximum strain criteria this number will correspond to the critical strain. For Hill and Norris criteria CRI = 1.

LAR = layer number where the stress is critical

PRCNT = percentage of laminae in the different fiber directions.

In the case of shear panels and bars only L, BASEA, L-C are printed.

7) The following information is given if the structure is to be analyzed only. The output is optional. It is printed only if LCHEK = 1 in the input Card Set 4.

L = element number not satisfying the strength criteria.

BASEA = ratio of actual state of stress to the maximum allowable stress. In the case of maximum strain criteria, BASEA is the ratio of strains and for the Hill and Norris criteria BASEA is the ratio of effective stress.

L-C = same as in Item 6

CRI = same as in Item 6

LAR = same as in Item 6

In the case of shear panels and bars only L, BASEA, L-C are printed.

8) MINIMUM WEIGHT CYCLE - the iteration number which gave the lowest weight design.

9) STRESSES - The following information is given under this heading for the minimum weight design

a) MEMB - element number

b) NODES - node numbers defining the element

c) AREA - area of the element ($in.^2$)

d) THICK - total thickness of the element (in.)

e) LAYER(THICK) - individual layer thickness (in.)

f) The following output are optional. They are printed only if proper control numbers are input in Card Set 4.

1) STRESSES IN INDIVIDUAL LAYERS (LOCAL COORDINATES)

2) STRESSES IN INDIVIDUAL LAYERS (ZERO FIBER DIRECTION)

3) STRAINS IN INDIVIDUAL LAYERS (FIBER DIRECTION)

4) AVERAGE STRESSES (ZERO FIBER DIRECTION)

5) STRESSES IN INDIVIDUAL LAYERS (FIBER DIRECTION)

6) EFFECTIVE STRESS

7) NODAL FORCES

For items 1 through 6 the stresses or strains are given for each loading condition on one line. The first number is the loading condition, then the layer numbers, and the stresses σ_1, σ_2, σ_{12} are printed out for each layer. The format can accommodate a maximum of four layers. In the case of average stresses only three stresses are given. The nodal forces are printed for each loading condition on one line. When NFOR = 2, Fx, Fy, Fz are given in the global coordinates and when NFOR = 1, Fx and Fy are given in the local coordinates. The sequence of nodal forces is the same as the sequence of numbers used to define the element.

In the case of shear panels MEMB, NODES, AREA, and THICK are given and for bar elements MEMB, NODES, LENGTH, and AREA are printed out. In these two cases since there is only one pertinent stress in the member, the loading conditions and stresses are printed on one line under the heading of stresses.

10) DISPLACEMENTS - The following information is given for each node under this heading for the minimum weight design

a) JOINT - Node number

b) X, Y, Z - x, y, z coordinates of the node

c) FORCE-X, FORCE-Y, FORCE-Z - Applied forces in the x, y, z directions.

d) DISPL-X, DISPL-Y, DISPL-Z - Displacement in the x, y, and z directions.

The quantities (c) and (d) are given for each loading condition.

11) NUMBER OF LAMINAE IN COMPOSITE ELEMENTS - The number of laminae in all composite elements are given. The element number is given in the parenthesis before the laminae numbers.

12) TOTAL THICKNESS OF ELEMENTS - The actual thicknesses of all the elements corresponding to the minimum weight design are listed.

13) If LNSB > 0 items 3 to 12 are repeated for the iterations used to modify the quadrilaterals and triangles to prevent local buckling.

14) REACTIONS - The format for this item is the same as Item 10, except that under the heading FORCE-X, FORCE-Y, FORCE-Z, the reactions are given corresponding to the fixed boundary conditions.

15) SUMMATION OF FORCES

a) Applied loads

LOAD	-	loading condition
MX	-	moment of applied forces about x axis through the origin
MY	-	moment of applied forces about y axis through the origin
MZ	-	moment of applied forces about z axis through the origin

b) REACTIONS - Same as (a) above except that the quantities are calculated for the reactions at the boundaries.

SECTION VI

ILLUSTRATIVE PROBLEM

A cantilever box-beam shown in Figure 5 is designed to illustrate the use of the computer program. The top and bottom skins consist of four layers with fibers in 0°, 90°, +45°, and -45°. The coordinates of the node numbers shown in Figure 5 are given in the computer output in the Appendix. There are 40 nodes and the nodes 37 through 40 are fixed. The total number of elements are 54. There are 18 quadrilaterals, 18 shear panels, and 18 posts. The 6 quadrilaterals at the tip of the box-beam consist of four layers of graphite epoxy. The 6 quadrilaterals in the middle consist of one layer of boron epoxy and three layers of graphite epoxy, and the remaining quadrilaterals consist of four layers of boron epoxy. The shear panels and posts have different elastic properties.

Number of elements - MEMBS = 54
Number of quadrilaterals - NC = 18
Number of shear panels and bars - NI = 36
Number of nodes - JOINTS = 40
Number of restrained degrees of freedom - NB = 12
Number of loading conditions - LOADS = 2
Number of degrees of freedom per node - MM = 3
Number of layers - NZ = 4
Coordinates of nodes given in feet - INCHES = 0
Applied loads given in kips - KIPS = 1
Number of materials used in shear panels and bars - NMAT1 = 2
Number of sets of materials used in quadrilaterals - NMAT2 = 3
Projection of 0° fibers is specified - NFIBER = 0
Maximum stress criteria - NCRTIA = 1
Recurrence relation used (Eq. 24) - NENG = 1
No linkage of elements - LINK = 0
No specified sizes of elements - MCONST = 0
Initial sizes of the elements not specified - NSTART = 0
Total number of iterations - LTSCCL - 15
Number of iterations to modify the design variables by using the recurrence relation - LLSTCL - 10
Number of iterations to modify the element sizes to prevent local buckling - LNSB - 8
Equal thickness of layers in +45° and -45° required - NBLNCE - 1

Relative sizes of elements required - NAREA = 1
Stresses in fiber direction needed - NFI = 1
Nodal forces in global coordinates required - NFOR = 2

Only the thickness of +45° and -45° layers are to be increased to prevent local buckling. Hence PECT(1) = 0.0; PECT(2) = 0.0; PECT(3) = 0.5; PECT(4) = 0.5.

In Card Set 12, material property number NMAT1 for all bars is 1 and for all shear panels is 2. The elastic properties for the two materials are as follows

	Material 1	Material 2
E	10.5×10^6 psi	30.0×10^6 psi
ν	0.3	0.3
G	-	-
Allowable Stress in Tension	25.0 kips/in^2	10.0 kips/in^2
Allowable Stress in Compression	20.0 kips/in^2	10.0 kips/in^2
Allowable Stress in Shear	15.0 kips/in^2	8.0 kips/in^2
Density	0.1 lbs/in^3	0.28 lbs/in^2

In Card Set 11 material property number NMAT2 for quadrilaterals 13 through 18 is 1; quadrilaterals 7 through 12 is 2 and quadrilaterals 1 through 6 is 3

	Material 1	Material 2	Material 1
0° layer	graphite-epoxy	boron-epoxy	boron-epoxy
90° layer	graphite-epoxy	graphite-epoxy	boron-epoxy
+45° layer	graphite-epoxy	graphite-epoxy	boron-epoxy
-45° layer	graphite-epoxy	graphite-epoxy	boron-epoxy

Elastic properties and allowable stresses for graphite epoxy and boron epoxy are as follows:

	graphite-epoxy	boron-epoxy
E_{11}	18.5×10^6 psi	32.0×10^6 psi
E_{22}	1.6×10^6 psi	3.5×10^6 psi
ν_{12}	0.208	0.25
ν_{21}	0.0203	-
G	0.65×10^6 psi	0.93×10^6 psi
density	.55 lbs/in^3	.0725 lbs/in^3
thickness of laminae	.0052	.0052
Minimum thickness of a layer	.0104	.0104
Allowable stress fiber direction (tension)	139.0 $kips/in^2$	166.0 $kips/in^2$
fiber direction (compression)	92.4 $kips/in^2$	86.0 $kips/in^2$
Allowable stress transverse fiber direction (tension)	4.95 $kips/in^2$	6.0 $kips/in^2$
fiber direction (compression)	29.7 $kips/in^2$	11.86 $kips/in^2$
Allowable stress shear	4.68 $kips/in^2$	3.95 $kips/in^2$

The projection of 0° fibers is defined by two points (0.0, 0.0, 0.0), (1.0, 0.0, 0.0). The third point defining the plane is (0.0, 1.0, 0.0). The line joining the first and second points is perpendicular to the line joining the first and the third points.

The four fiber orientations are 0°, 90°, +45°, and -45°.

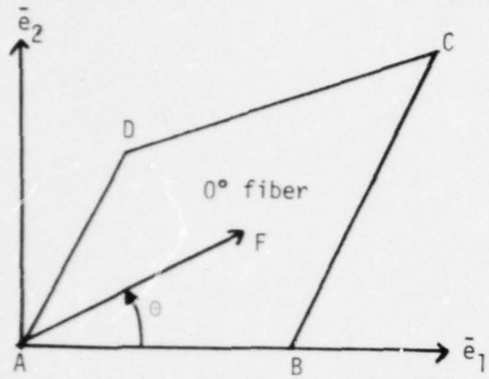
The element connections and coordinates of the nodes are given in the output of the program. The sequence of defining the elements is as shown in Figure 4.

The minimum thickness of all elements is .01 inch.

For all quadrilaterals AWIDE = 9.0 in
For all quadrilaterals BWIDE = 12.0 in

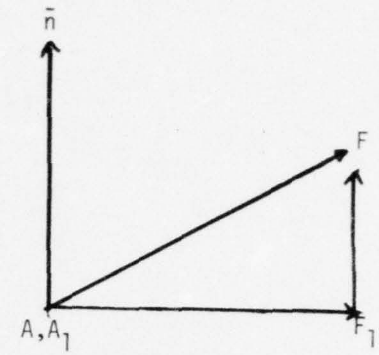
Nodes 37 through 40 are fixed. Hence, the restrained degrees of freedom are 109 through 120.

The first loading condition consists of a 1 kip load at nodes 1, 2, 3 and 4 acting in the negative z direction. The second loading condition consists of a 0.5 kip load at nodes 2 and 4 acting in the negative z direction.

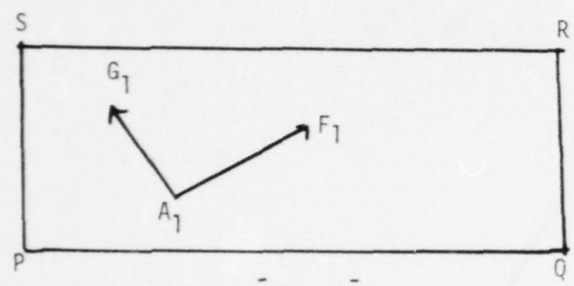


$\bar{e}_n = \bar{e}_1 \times \bar{e}_2$

(a) fiber direction



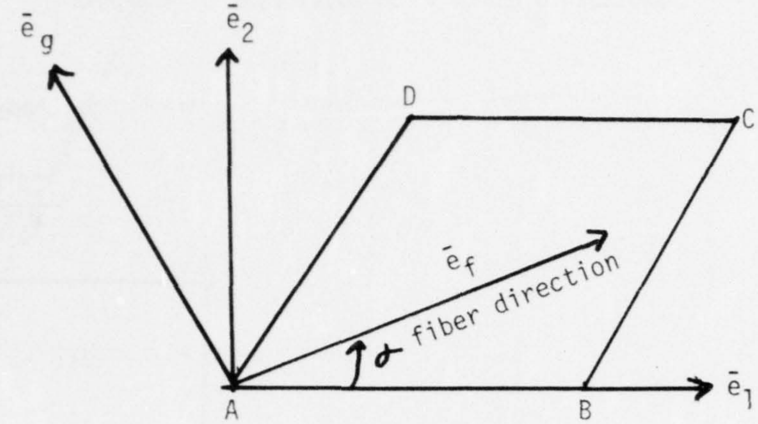
(c) fiber direction and projection



$$\bar{n} = \frac{\bar{A}_1F_1 \times \bar{A}_1G_1}{|\bar{A}_1F_1 \times \bar{A}_1G_1|}$$

(b) projection

FIGURE 1. DEFINITION OF 0° FIBER DIRECTIONS



$\bar{e}_n = \bar{e}_1 \times \bar{e}_2 = \bar{e}_f \times \bar{e}_g$

$(\bar{e}_1, \bar{e}_2, \bar{e}_n)$ local coordinate system of the element ABCD

$(\bar{e}_f, \bar{e}_g, \bar{e}_n)$ material coordinate system

FIGURE 2. LOCAL AND FIBER COORDINATE SYSTEMS

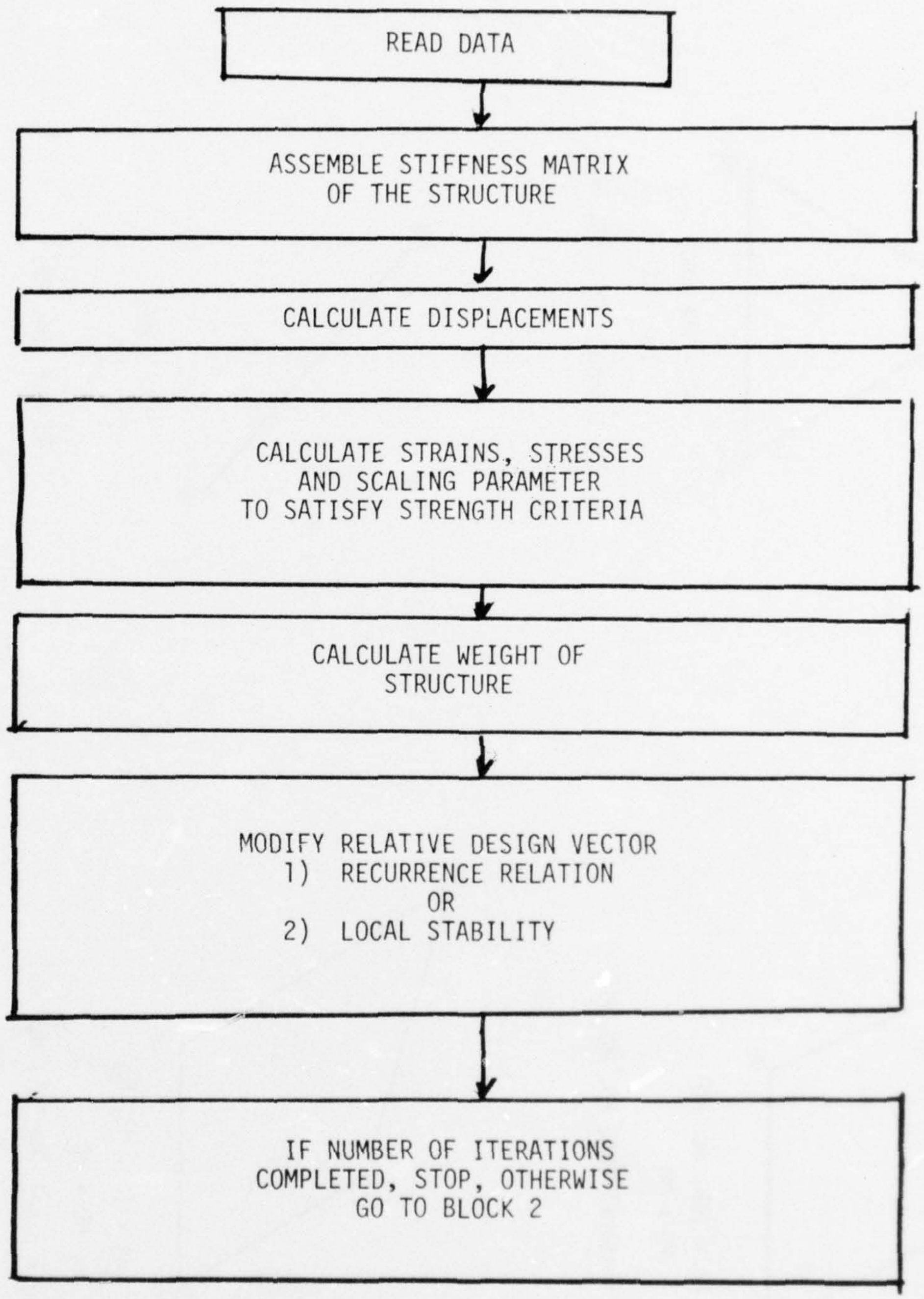


FIGURE 3. FLOW DIAGRAM

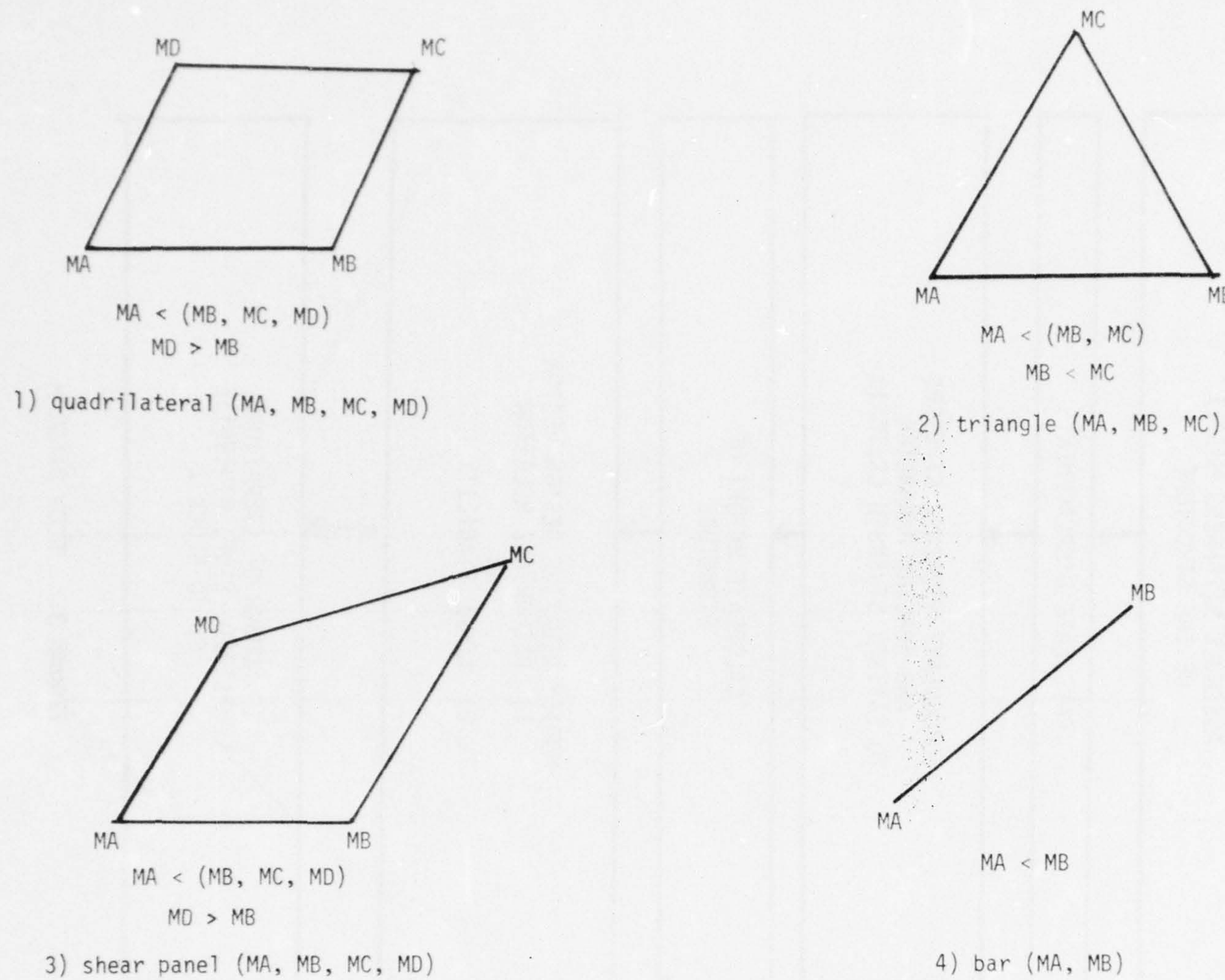


FIGURE 4. NODAL NUMBERING SYSTEM FOR ELEMENTS

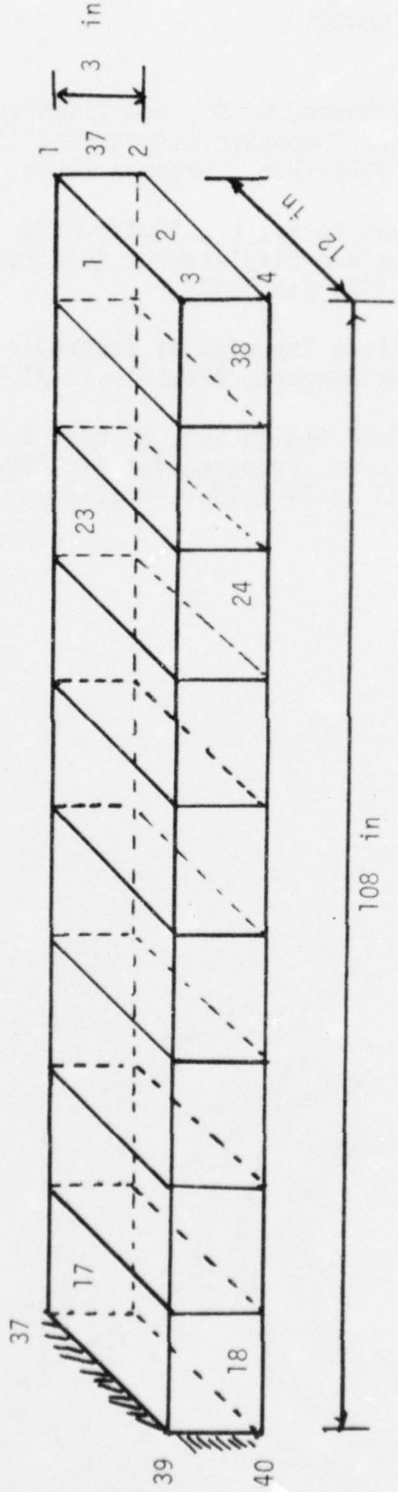


FIGURE 5. Cantilever Box-Beam

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1. Khot, N. S., Venkayya, V. B., Johnson, C. D., and Tischler, V. A., "Optimization of Fiber Reinforced Composite Structures," Int. J. Solids Structures, Vol. 9, pp. 1225-1236, Pergamon Press, Sept. 1973.

2. Khot, N. S., Venkayya, V. B., and Berke, L., "Optimum Design of Composite Structures with Stress and Displacement Constraints," AIAA Journal, Vol. 14, pp. 131-132, Feb. 1976.

3. Sandhu, R. S., "A Survey of Failure Theories of Isotropic and Anisotropic Materials," Technical Report, AFFDL-TR-72-71, Sept. 72.

4. "Advanced Composites Design Guide" Design Vol. 2, Book 2, Division of the North American Rockwell Corp. Prepared for Air Force Materials Lab. (AFML/LC), Contract No. F33615-71-C-1362, Nov.1971.

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UNLABELED OLDPL          MODIFICATIONS / CONTROL CARDS          UPDATE 1.2-76088.    10/29/76  12.19.53.     PAGE   1


          CORRECTION IDENTS ARE LISTED IN CHRONOLOGICAL ORDER OF INSERTION

      MAIN      MEMB      SUGD      AVECT     SURF      COORD     ELAS      STRAIN
      COMP      ESTIF     ASEMBL    CONDNS    SUM       CHANG     TRNSF     POP
      GAUSS     BOUND     PRNTD     REDUCE    RESTOR    ELSTRS    SCOMP     SSRS
      BFORCE    SBUCK     ANORM     MULT      ENGS      STRESS    SHILL     AVG
      AEQ       ALINK


DECKS ARE LISTED IN THE ORDER OF THEIR OCCURRENCE ON A NEW PROGRAM LIBRARY IF ONE IS CREATED BY THIS UPDATE

      YANK$$$   MAIN      MEMB      SUGD      AVECT     SURF      COORD     ELAS
      STRAIN    COMP      ESTIF     ASEMBL    CONDNS    SUM       CHANG     TRNSF
      POP       GAUSS     BOUND     PRNTD     REDUCE    RESTOR    ELSTRS    SCOMP
      SSRS      BFORCE    SBUCK     ANORM     MULT      ENGS      STRESS    SHILL
      AVG       AEQ       ALINK


      DECKS WRITTEN TO COMPILE FILE

      MAIN      MEMB      SUGD      AVECT     SURF      COORD     ELAS      STRAIN
      COMP      ESTIF     ASEMBL    CONDNS    SUM       CHANG     TRNSF     POP
      GAUSS     BOUND     PRNTD     REDUCE    RESTOR    ELSTRS    SCOMP     SSRS
      BFORCE    SBUCK     ANORM     MULT      ENGS      STRESS    SHILL     AVG
      AEQ       ALINK

1THIS UPDATE REQUIRED  34100B WORDS OF CORE.
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PROGRAM OPTCOMP    74/74   OPT=1                       FTN 4.5+414        10/29/76  12.20.38          PAGE   1

      PROGRAM OPTCOMP(INPUT,TAPE5=INPUT,OUTPUT,TAPE6=OUTPUT)
C  PROGRAM*************OPTCOMP**********
C  THIS COMPUTER PROGRAM CAN BE USED TO ANALYZE OR OPTIMIZE
C  COMPOSITE STRUCTURES. THE PLATE ELEMENTS CAN BE DESIGNED TO
C  PREVENT LOCAL BUCKLING
      COMMON /AA/ NEF,NAVG,NFULL,NCHK,NCRTIA,NSTBLTY,NLO,NFI,NZEO,NSTRN,
     1NFOR,NENG,NBLNCE,LAST,LNSB,ABAS,CBAS,LSKIN,LINT,MEMBS,MM,E1,BASEAE
     2,BASEA,NFIBER,LSTCCL,LCHEK
      COMMON /BB/ MAA,MBB,MCC,EK,EKK,B,C,XI,ETA,ZI,XXI,YII,XO,YO,ZO,SSMA
     1X,THE,THETA,EKL,E,AEE,CC,AA,AAA,AE,AB,DA,EE,EO
      COMMON /CC/ E11,E22,ANU1,ANU2,GSH
C  ACTUAL DIMENSIONS MUST BE GREATER THAN OR EQUAL TO THE DIMENSIONS
C  MENTIONED UNDER THE COMMENT CARDS. THE DIMENSIONS OF UNMENTIONED
C  VARIABLES ARE INDEPENDENT OF THE SIZE OF THE PROBLEM
C  X,Y,Z,--(JOINTS)$$$IDIAG,ICOL,IDIAGS,ICOLS,--(MM*JOINTS)$$$
C  SK,--(NMAX)$$$IBND,--(NB)$$$FR,DR,--(MM*JOINTS,LOADS)$$$
C  NJLODS,--(LOADS)$$$
C  MA,MB,MC,MD,A,KTYPE,ELENTH,BMAX,BMIN,NMAT,--(MEMBS)$$$
C  AL,STRENG,AAEL,NLYRS,SSTHK,--(NC,NZ)$$$AWIDE,BWIDE,ZANGLE,--(NC)$$$
C  STNG,ENGL,AAEI,AENG,NANEG,--(NI)$$$AEE,CC,--(9,NMAT2,NZ)$$$
C  E11,E22,ANU1,ANU2,SPWTC,THMIN,GSH,CNU,THEK,--(NZ,NMAT2)$$$
C  S1,S2,S3,S4,S5,S6,S7,S8,ANGLE,PECT,AM,AN,--(NZ)$$$
C  E,PMU,GSHE,SSTRT,SSTRC,SSTRS,SPWTT,--(NMAT1)$$$SSMAX,--(5,NZ,NMAT2)$$
C  THE,THETA,--(NZ,3)$$$NLINK,--(LNK)$$$NELEM(LNK,LMAX)$$$
C  LMAX=MAX NUMBER OF ELEMENTS MENTIONED IN NLINK
C  MEMBS=NC+NI
C  NCC=NC$$$NZK=MM*JOINTS$$$NMAX=DIMENSION OF SK
C  NCC,NZK NMAX ARE DEFINED AFTER THE DIMENSION CARDS
      DIMENSION X(50), Y(50), Z(50), IDIAG(150), ICOL(150), IDIAGS(150),
     1 ICOLS(150)
      DIMENSION SK(5000), IBND(50)
      DIMENSION FR(150,2), DR(150,2), NJLODS(2)
      DIMENSION MA(120), MB(120), MC(120), MD(120), A(120), KTYPE(120),
     1ELENTH(120), BMAX(120), BMIN(120), NMAT(120)
      DIMENSION AL(50,4), STRENG(50,4), AAEL(50,4), NLYRS(50,4), SSTHK(5
     10,4), AWIDE(50), BWIDE(50), ZANGLE(50)
      DIMENSION STNG(70), ENGL(70), AAEI(70), ANEG(70), NANEG(70)
      DIMENSION AEE(9,4,4), CC(9,4,4), E11(4,4), E22(4,4), ANU1(4,4), AN
     1U2(4,4), SPWTC(4,4), THMIN(4,4), GSH(4,4), CNU(4,4), THEK(4,4), S1
     2(4), S2(4), S3(4), S4(4), S5(4), S6(4), S7(4), S8(4), ANGLE(4), PE
     3CT(4), AM(4), AN(4), E(4), PMU(4), GSHE(4), SSTRT(4), SSTRC(4), SS
     4TRS(4), SPWTT(4), SSMAX(5,4,4), THE(4,3), THETA(4,3)
      DIMENSION NLINK(5), NELEM(5,10)
      DIMENSION AA(3,3), AB(3), EK(12,12), XI(5), ETA(5), C(12,12), B(12
     1,12), I1(3), JM(3), TFR(3), XXI(5), YII(5), ZI(5), EKK(12,12), AAA
     2(3,3), MAA(4), MBB(4), MCC(4), AE(3,3), EE(3,3), EO(3), EKL(12,12)
     3, DA(3,3), XO(3), YO(3), ZO(3), AC(3,3)
      DIMENSION HED(8)
      PRINT 107
      NMAX=5000
      NCC=50
      NZK=150
      NON=1
      NTO=2
      NTH=3
      NTW=12
      NZERO=0
```

```
      WRITE (6,108)
      READ (5,125) NSTR
      WRITE (6,125) NSTR
      KSTR=1
    1 CONTINUE
      IF (KSTR.GT.1) WRITE (6,108)
      READ (5,109) HED
      WRITE (6,110) KSTR,HED
      ATIME=SECOND(AAZ)
      WRITE (6,146) ATIME
      READ (5,125) MEMBS,NC,NI,JOINTS,NB,LOADS,MM,NZ,INCHES,KIPS,NMAT1,N
     1MAT2,NFIBER,NCRTIA,NENG,LINK,MCONST,NSTART,LSTCCL,LLSTCL,LNSB,NBLN
     2CE
      WRITE (6,111) MEMBS,NC,NI,JOINTS,NB,LOADS,MM,NZ,INCHES,KIPS,NMAT1,
     1NMAT2,NFIBER,NCRTIA,NENG,LINK,MCONST,NSTART,LSTCCL,LLSTCL,LNSB,NBL
     2NCE
      READ (5,125) NAREA,NLO,NZEO,NSTRN,NAVG,NFI,NEF,NFOR,LCHEK
      WRITE (6,111) NAREA,NLO,NZEO,NSTRN,NAVG,NFI,NEF,NFOR,LCHEK
      NN=MM*JOINTS
      NM=NN-NB
      IF (LNSB.EQ.0) GO TO 2
      READ (5,126) (PECT(I),I=1,NZ)
      WRITE (6,112) (PECT(I),I=1,NZ)
    2 CONTINUE
      IF (NENG.EQ.4) LLSTCL=LSTCCL+1
      LISS=LLSTCL-1
      DO 3 I=1,NMAT1
      READ (5,113) E(I),PMU(I),GSHE(I),SSTRT(I),SSTRC(I),SSTRS(I),SPWTT(
     1I)
      WRITE (6,114) E(I),PMU(I),GSHE(I),SSTRT(I),SSTRC(I),SSTRS(I),SPWTT
     1(I)
    3 CONTINUE
      IF (NC.EQ.0) GO TO 8
      READ (5,115) ((E11(I,J),E22(I,J),ANU1(I,J),ANU2(I,J),GSH(I,J),SPWT
     1C(I,J),THEK(I,J),THMIN(I,J),I=1,NZ),J=1,NMAT2)
      WRITE (6,116) ((E11(I,J),E22(I,J),ANU1(I,J),ANU2(I,J),GSH(I,J),SPW
     1TC(I,J),THEK(I,J),THMIN(I,J),I=1,NZ),J=1,NMAT2)
      DO 4 J=1,NMAT2
      DO 4 K=1,NZ
      READ (5,117) (SSMAX(I,K,J),I=1,5)
      WRITE (6,118) (SSMAX(I,K,J),I=1,5)
    4 CONTINUE
      IF (NFIBER.EQ.1) GO TO 6
      DO 5 I=1,NTH
      READ (5,119) XD(I),YD(I),ZD(I)
      WRITE (6,120) XD(I),YD(I),ZD(I)
    5 CONTINUE
    6 CONTINUE
      READ (5,126) (ANGLE(I),I=1,NZ)
      WRITE (6,112) (ANGLE(I),I=1,NZ)
      DO 7 J=1,NC
      READ (5,121) I,KTYPE(I),NMAT(I),MA(I),MB(I),MC(I),MD(I),BMAX(I),BM
     1IN(I),AWIDE(I),BWIDE(I),ZANGLE(I)
      WRITE (6,122) I,KTYPE(I),NMAT(I),MA(I),MB(I),MC(I),MD(I),BMAX(I),B
     1MIN(I),AWIDE(I),BWIDE(I),ZANGLE(I)
      ZANGLE(I)=ZANGLE(I)*3.1415926/180.
    7 CONTINUE
```

```
      8     CONTINUE                                                         MAIN    116
            NK=NC+1                                                          MAIN    117
            DO 9 J=NK,MEMBS                                                  MAIN    118
            READ (5,121) I,KTYPE(I),NMAT(I),MA(I),MB(I),MC(I),MD(I),BMAX(I),BM MAIN  119
           1IN(I)                                                            MAIN    120
            WRITE (6,122) I,KTYPE(I),NMAT(I),MA(I),MB(I),MC(I),MD(I),BMAX(I),B MAIN  121
           1MIN(I)                                                           MAIN    122
      9     CONTINUE                                                         MAIN    123
            IF (LINK.EQ.0) GO TO 11                                          MAIN    124
            READ (5,125) LNK,NSKIN,NINT                                      MAIN    125
            WRITE (6,111) LNK,NSKIN,NINT                                     MAIN    126
            READ (5,125) (NLINK(I),I=1,LNK)                                  MAIN    127
            WRITE (6,111) (NLINK(I),I=1,LNK)                                 MAIN    128
            DO 10 K=1,LNK                                                    MAIN    129
            KX=NLINK(K)                                                      MAIN    130
            READ (5,125) (NELEM(K,J),J=1,KX)                                 MAIN    131
            WRITE (6,111) (NELEM(K,J),J=1,KX)                                MAIN    132
     10     CONTINUE                                                         MAIN    133
     11     CONTINUE                                                         MAIN    134
            IF (NSTART.EQ.1) GO TO 12                                        MAIN    135
            IF (LSTCCL.GT.0) GO TO 15                                        MAIN    136
     12     CONTINUE                                                         MAIN    137
            IF (NC.EQ.0) GO TO 13                                            MAIN    138
            DO 14 L=1,NZ                                                     MAIN    139
            READ (5,126) (AL(I,L),I=1,NC)                                    MAIN    140
            WRITE (6,112) (AL(I,L),I=1,NC)                                   MAIN    141
     14     CONTINUE                                                         MAIN    142
     13     CONTINUE                                                         MAIN    143
            K1=NC+1                                                          MAIN    144
            READ (5,126) (A(I),I=K1,MEMBS)                                   MAIN    145
            WRITE (6,112) (A(I),I=K1,MEMBS)                                  MAIN    146
     15     CONTINUE                                                         MAIN    147
            DO 16 J=1,JOINTS                                                 MAIN    148
            READ (5,124) I,X(I),Y(I),Z(I)                                    MAIN    149
            WRITE (6,123) I,X(I),Y(I),Z(I)                                   MAIN    150
     16     CONTINUE                                                         MAIN    151
            READ (5,125) (IBND(I),I=1,NB)                                    MAIN    152
            WRITE (6,111) (IBND(I),I=1,NB)                                   MAIN    153
            DO 17 I=1,NN                                                     MAIN    154
            DO 17 J=1,LOADS                                                  MAIN    155
            DR(I,J)=0                                                        MAIN    156
     17     FR(I,J)=0                                                        MAIN    157
            READ (5,125) (NJLODS(I),I=1,LOADS)                               MAIN    158
            WRITE (6,111) (NJLODS(I),I=1,LOADS)                              MAIN    159
            DO 23 J=1,LOADS                                                  MAIN    160
            KH=NJLODS(J)                                                     MAIN    161
     18     IF (KH-3) 19,19,20                                               MAIN    162
     19     KX=KH                                                            MAIN    163
            GO TO 21                                                         MAIN    164
     20     KX=3                                                             MAIN    165
     21     READ (5,128) (TFR(I),IM(I),JM(I),I=1,KX)                         MAIN    166
            WRITE (6,127) (TFR(I),IM(I),JM(I),I=1,KX)                        MAIN    167
            DO 22 I=1,KX                                                     MAIN    168
            KY=MM*JM(I)-MM+IM(I)                                             MAIN    169
     22     FR(KY,J)=FR(KY,J)+TFR(I)                                         MAIN    170
            KH=KH-KX                                                         MAIN    171
            IF (KH) 23,23,18                                                 MAIN    172
```

```
 23   CONTINUE
      DO 24 I=1,NMAT1
      IF (GSHE(I).EQ.0.) GSHE(I)=E(I)/(2.*(1+PMU(I)))
      E(I)=E(I)*10.0**6
      GSHE(I)=GSHE(I)*10.0**6
 24   CONTINUE
      DO 25 I=1,NZ
      ANGLE(I)=3.1415926536*ANGLE(I)/180.
      THE(I,1)=COS(ANGLE(I))
      THE(I,2)=SIN(ANGLE(I))
 25   THE(I,3)=0.0
      E1=E(1)
      IF (NI.EQ.0) E1=E11(1,1)*10.**6
      IF (NC.EQ.0) GO TO 27
      DO 26 J=1,NMAT2
      DO 26 I=1,NZ
      E11(I,J)=E11(I,J)*10.**6
      E22(I,J)=E22(I,J)*10.**6
      GSH(I,J)=GSH(I,J)*10.**6
      IF (GSH(I,J).EQ.0.) GSH(I,J)=E11(I,J)/(2.*(1.+ANU1(I,J)))
      IF (ANU2(I,J).EQ.0.) ANU2(I,J)=ANU1(I,J)*E22(I,J)/E11(I,J)
      CNU(I,J)=1.-ANU1(I,J)*ANU2(I,J)
      C11=E11(I,J)/CNU(I,J)
      C22=E22(I,J)/CNU(I,J)
      C12=C22*ANU1(I,J)
      C66=GSH(I,J)
      C16=0.0
      C26=0.0
      AEE(1,I,J)=C11/E1
      AEE(5,I,J)=C22/E1
      AEE(2,I,J)=AEE(5,I,J)*ANU1(I,J)
      AEE(9,I,J)=GSH(I,J)/E1
      AEE(4,I,J)=AEE(2,I,J)
      AEE(6,I,J)=0.0
      AEE(8,I,J)=0.0
      AEE(3,I,J)=0.0
      AEE(7,I,J)=0.0
      AM(I)=COS(ANGLE(I))
      AN(I)=SIN(ANGLE(I))
      S1(I)=AM(I)**4
      S2(I)=AM(I)**2*AN(I)**2
      S3(I)=AM(I)**3*AN(I)
      S4(I)=AN(I)**4
      S5(I)=AM(I)*AN(I)**3
      S6(I)=AM(I)**2
      S7(I)=AN(I)**2
      S8(I)=AM(I)*AN(I)
      L=I
      CC(1,L,J)=S1(L)*C11+2.*S2(L)*C12+4.*S3(L)*C16+S4(L)*C22+4.*S5(L)*C
     126+4.*S2(L)*C66
      CC(2,L,J)=S2(L)*C11+(S1(L)+S4(L))*C12+2.*(S5(L)-S3(L))*C16+S2(L)*C
     122+2.*(S3(L)-S5(L))*C26-4.*S2(L)*C66
      CC(4,L,J)=CC(2,L,J)
      CC(3,L,J)=-S3(L)*C11+(S3(L)-S5(L))*C12+(S1(L)-3.*S2(L))*C16+S5(L)*
     1C22+(3.*S2(L)-S4(L))*C26+2.*(S3(L)-S5(L))*C66
      CC(7,L,J)=CC(3,L,J)
```

```
      126+4.*S2(L)*C66
       CC(6,L,J)=-S5(L)*C11+(S5(L)-S3(L))*C12+(3.*S2(L)-S4(L))*C16+S3(L)*
      1C22+(S1(L)-3.*S2(L))*C26+(S5(L)-S3(L))*2.*C66
       CC(8,L,J)=CC(6,L,J)
       CC(9,L,J)=S2(L)*C11-2.*S2(L)*C12+2.*(S5(L)-S3(L))*C16+S2(L)*C22+2.
      1*(S3(L)-S5(L))*C26+(S6(L)-S7(L))**2*C66
   26 CONTINUE
   27 CONTINUE
      IF (NSTART.EQ.1) GO TO 28
      IF (LSTCCL.GT.0) GO TO 29
   28 CONTINUE
      CALL ANORM (A,AL,MEMBS,AMAX,NC,NZ,NCC)
      BASEA=AMAX
      BASEAE=BASEA*E1
   29 CONTINUE
      IF (INCHES.EQ.1) GO TO 31
      DO 30 I=1,JOINTS
      X(I)=X(I)*12.0
      Z(I)=Z(I)*12.0
   30 Y(I)=Y(I)*12.0
   31 CONTINUE
      IF (KIPS.NE.1) GO TO 35
      DO 32 I=1,NN
      DO 32 J=1,LOADS
   32 FR(I,J)=1000.0*FR(I,J)
      DO 33 I=1,NMAT1
      SSTRT(I)=SSTRT(I)*1000.
      SSTRC(I)=SSTRC(I)*1000.
      SSTRS(I)=SSTRS(I)*1000.
   33 CONTINUE
      IF (NCRTIA.EQ.2) GO TO 35
      DO 34 I=1,NMAT2
      DO 34 K=1,NZ
      DO 34 J=1,5
      SSMAX(J,K,I)=SSMAX(J,K,I)*1000.
   34 CONTINUE
   35 CONTINUE
      DO 36 I=1,MEMBS
      BMAX(I)=BMAX(I)*E1
   36 BMIN(I)=BMIN(I)*E1
      CALL POP (MEMBS,JOINTS,MM,MA,MB,MC,MD,KTYPE,ICOL,IDIAG,NONZRO)
      IF (NONZRO.LT.NMAX) GO TO 37
      WRITE (6,129) NONZRO
      GO TO 105
   37 CONTINUE
      DO 38 I=1,NN
      ICOLS(I)=ICOL(I)
   38 IDIAGS(I)=IDIAG(I)
      IF (LSTCCL.EQ.0) GO TO 41
      ZN=FLOAT(NZ)
      AZN=0.1/ZN
      DO 39 I=1,NC
      A(I)=0.1
      DO 39 J=1,NZ
   39 AL(I,J)=AZN
      K1=NC+1
      DO 40 I=K1,MEMBS
```

```
      A(I)=0.1
   40 IF (KTYPE(I).EQ.2) A(I)=1.0
   41 CONTINUE
      DO 42 I=1,NN
      DO 42 J=1,LOADS
   42 DR(I,J)=0.0
      WTLAST=0.0
      LAST=0
      KCOUNT=1
      NNEQ=0
      NANLIS=1
      NSTBLTY=0
      MFORCE=0
      BAZSEA=0.0
      NPAGE=0
      WMIN=10.**20
      DO 43 I=1,4
      ZI(I)=0.
      MAA(I)=I
      MBB(I)=I+1
   43 MCC(I)=5
      ZI(5)=0.
      MAA(4)=1
      MBB(4)=4
      NZERO=0
   44 L=1
      NDUM=0
      DO 45 I=1,NN
      ICOL(I)=ICOLS(I)
   45 IDIAG(I)=IDIAGS(I)
      DO 46 I=1,NONZRO
   46 SK(I)=0
      ATIME=SECOND(AAZ)
      WRITE (6,146) ATIME
      IF (NAREA.EQ.0) GO TO 48
      WRITE (6,144)
      WRITE (6,143) (A(I),I=1,MEMBS)
      WRITE (6,130)
      DO 47 J=1,NZ
      WRITE (6,143) (AL(I,J),I=1,NC)
      WRITE (6,130)
   47 CONTINUE
   48 CONTINUE
      IF (NSTBLTY.GT.1) NRITE=1
      NRITE=0
      KM=NMAT(L)
      KNODE=4
      IF (KTYPE(L).LE.4) KNODE=KTYPE(L)
      CALL COORD (MA(L),MB(L),MC(L),MD(L),X,Y,Z,AA,XI,ETA,PL,KNODE,NZERO
     1,AB)
      IF (L.GT.NC) GO TO 49
      IF (NFIBER.EQ.1) FANGLE=ZANGLE(L)
```

```
      DO 51 I=1,12
      DO 51 J=1,12
      C(I,J)=0.0
 51   EK(I,J)=0.
      QUAD=0.
      DO 57 I=1,4
      CALL COORD (MAA(I),MBB(I),MCC(I),MD(I),XI,ETA,ZI,AAA,XXI,YII,PL,NT
     1H,NZERO,AB)
      DO 52 JK=1,12
      DO 52 IK=1,12
 52   EKK(IK,JK)=0.0
      DO 56 IL=1,NZ
      THK=AL(L,IL)
      DO 53 KL=1,3
 53   EO(KL)=THETA(IL,KL)
      JK=0
      DO 54 J1=1,3
      DO 54 K1=1,3
      JK=JK+1
 54   AE(J1,K1)=AEE(JK,IL,KM)
      CALL ELAS (AAA,AB,AE,EO,DA,EE)
      CALL COMP (EKL,THK,TRIANG,XXI,YII,EE)
      DO 55 IK=1,6
      DO 55 JK=1,6
 55   EKK(IK,JK)=EKK(IK,JK)+EKL(IK,JK)
 56   CONTINUE
      QUAD=QUAD+TRIANG
      CALL TRNSFM (EKK,AAA,B,C,NTO,NTH,NT4)
      CALL SUM (EK,C,MAA(I),MBB(I),MCC(I))
 57   CONTINUE
      NZERO=0
      CALL CONONS (EK,EKK,MA(L),MB(L),MC(L),MD(L),NZERO)
      GO TO 66
 58   CONTINUE
      DO 59 I=1,3
      DO 59 J=1,3
 59   AC(I,J)=0.0
      AC(1,1)=1.0
      AC(2,2)=1.0
      DO 60 I=1,6
      DO 60 J=1,6
 60   EK(I,J)=0.0
      DO 64 I=1,NZ
      THK=AL(L,I)
      DO 61 K=1,3
 61   EO(K)=THETA(I,K)
      JK=0
      DO 62 J1=1,3
      DO 62 K1=1,3
      JK=JK+1
 62   AE(J1,K1)=AEE(JK,I,KM)
      CALL ELAS (AC,AB,AE,EO,DA,EE)
      CALL COMP (EKL,THK,QUAD,XI,ETA,EE)
      DO 63 KI=1,6
      DO 63 KJ=1,6
 63   EK(KI,KJ)=EK(KI,KJ)+EKL(KI,KJ)
 64   CONTINUE
```

```
      GO TO 66
   65 CONTINUE
      CALL SCOMP (EK,A(L),QUAD,XI,ETA,GSHE(KM),E1)
      CALL CONONS (EK,EKK,MA(L),MB(L),MC(L),MD(L),NTO)
   66 CONTINUE
      CALL TRNSFM (EK,AA,B,C,MM,KNODE,NTW)
      GO TO 68
   67 CONTINUE
      EBAR=E(KM)
      CALL ELSTIF (AA,B,C,A(L),MM,PL,EBAR,E1)
      QUAD=PL
   68 CONTINUE
      IF (NRITE.EQ.1) WRITE (6,131) ((C(I,J),J=1,8),I=1,8)
      CALL ASEMBL (SK,C,MA(L),MB(L),MC(L),MD(L),MM,IDIAG,KNODE,NTW)
      IF (L.GE.MEMBS) GO TO 69
      L=L+1
      GO TO 43
   69 CONTINUE
      IF (MFORCE.EQ.0) GO TO 71
      DO 70 I=1,NONZRO
   70 SK(I)=SK(I)*BASEAE
      CALL MULT (SK,FR,DR,ICOL,IDIAG,NN,LOADS,NZK)
      CALL PRNTDR (FR,DR,X,Y,Z,IBND,NN,MM,LOADS,JOINTS,NPAGE,NB,NON,NZK)
      CALL AEJ (X,Y,Z,FR,IBND,NZK,LOADS,JOINTS,NB,MM)
      GO TO 105
   71 CONTINUE
      CALL BOUND (SK,IBND,NN,NB,IDIAG,ICOL)
      CALL REDUCE (FR,IBND,NN,NB,LOADS,NZK)
      CALL GAUSS (SK,FR,DR,ICOL,IDIAG,LOADS,NM,NZK,NZERO)
      ATIME=SECOND(AAZ)
      IF (LSTCOL.EQ.0) GO TO 72
      BASEAE=100.
      BASEA=BASEAE/E1
   72 CONTINUE
      CALL RESTOR (FR,IBND,NN,NB,LOADS,NZK)
      CALL RESTOR (DR,IBND,NN,NB,LOADS,NZK)
      NFULL=0
      IF (KCOUNT.GE.LLSTCL.AND.NSTBLTY.EQ.0.AND.LAST.EQ.0) NFULL=1
      IF (NENG.EQ.4) NFULL=0
      IF (KCOUNT.GT.LLSTCL.AND.NFULL.EQ.1) NNEQ=NNEQ+1
      NCHK=0
      NDLIS=0
      CALL MEMB (X,Y,Z,MA,MB,MC,MD,KTYPE,A,DR,STRENG,AL,ELENTH,SSTHK,ZAN
     1GLE,STNG,ENGL,NMAT,SSTRT,SSTRC,SSTRS,GSHE,AWIDE,BWIDE,ANEG,NANEG,P
     2ECT,NC,NZ,LOADS,NCC,NZK,NON)
      IF (MCONST.EQ.0) GO TO 73
      IF (LAST.EQ.1) GO TO 73
      WRITE (6,132) NANLIS
      PBASE=0.001*BASEA
      DBASE=ABS(BAZSEA-BASEA)
      WRITE (6,133) BASEA,DBASE
      IF (DBASE.LE.PBASE) GO TO 73
      IF (NANLIS.GT.2) GO TO 73
      BAZSEA=BASEA
```

```
   73  CONTINUE                                          MAIN    458
       BAZSEA=0                                          MAIN    459
       NANLIS=1                                          MAIN    460
       WSKIN=0.0                                         MAIN    461
       IF (NC.EQ.0) GO TO 75                             MAIN    462
       DO 74 L=1,NC                                      MAIN    463
       KM=NMAT(L)                                        MAIN    464
       DO 74 J=1,NZ                                      MAIN    465
       SPWT=SPWTC(J,KM)                                  MAIN    466
   74  WSKIN=WSKIN+AL(L,J)*BASEA*ELENTH(L)*SPWT          MAIN    467
   75  CONTINUE                                          MAIN    468
       WSHEAR=0.0                                        MAIN    469
       WPOST=0.0                                         MAIN    470
       K1=NC+1                                           MAIN    471
       DO 76 L=K1,MEMBS                                  MAIN    472
       KM=NMAT(L)                                        MAIN    473
       SPWT=SPWTT(KM)                                    MAIN    474
       WELE=A(L)*BASEA*ELENTH(L)*SPWTT(KM)               MAIN    475
       IF (KTYPE(L).EQ.5) WSHEAR=WSHEAR+WELE             MAIN    476
       IF (KTYPE(L).EQ.2) WPOST=WPOST+WELE               MAIN    477
   76  CONTINUE                                          MAIN    478
       WEIGHT=WSKIN+WSHEAR+WPOST                         MAIN    479
       WRITE (6,145) WSKIN,WSHEAR,WPOST,WEIGHT           MAIN    480
       WRITE (6,134) LSKIN,ABAS,LINT,CBAS                MAIN    481
       AABAS=ABAS                                        MAIN    482
       WRITE (6,142) KSTR,LOADS,KCOUNT,NNEQ,NSTBLTY      MAIN    483
       IF (LAST.EQ.1) WRITE (6,135) NNCYCL               MAIN    484
       DO 77 I=1,NN                                      MAIN    485
       DO 77 J=1,LOADS                                   MAIN    486
   77  DR(I,J)=DR(I,J)/BASEAE                            MAIN    487
       IF (KCOUNT.EQ.LISS) GO TO 78                      MAIN    488
       IF (NSTBLTY.GE.1) GO TO 95                        MAIN    489
       IF (LSTCCL.EQ.0) GO TO 95                         MAIN    490
       IF (KCOUNT.EQ.1) GO TO 85                         MAIN    491
       IF (LAST.GE.1) GO TO 95                           MAIN    492
       IF (KCOUNT.GT.LSTCCL) GO TO 78                    MAIN    493
       GO TO 85                                          MAIN    494
   78  CONTINUE                                          MAIN    495
       IF (WEIGHT.GT.WMIN) GO TO 81                      MAIN    496
       NNCYCL=KCOUNT                                     MAIN    497
       WMIN=WEIGHT                                       MAIN    498
       BLAST=BASEAE                                      MAIN    499
       DO 79 I=1,NC                                      MAIN    500
       DO 79 J=1,NZ                                      MAIN    501
   79  AAEL(I,J)=AL(I,J)                                 MAIN    502
       DO 80 L=1,NI                                      MAIN    503
       K1=L+NC                                           MAIN    504
   80  AAEI(L)=A(K1)                                     MAIN    505
       GO TO 84                                          MAIN    506
```

```
 83   CONTINUE
 84   CONTINUE
      CALL ANORM (A,AL,MEMBS,AMAX,NC,NZ,NCC)
      KCOUNT=KCOUNT+1
      IF (KCOUNT.EQ.LLSTCL) GO TO 44
      LAST=LAST+1
      BASEAE=BLAST
      BASEA=BLAST/E1
      GO TO 83
 85   CONTINUE
      IF (WEIGHT.LT.WMIN) NNCYCL=KCOUNT
      IF (LINK.EQ.1) CALL ALINK (A,AL,STRENG,STNG,ELENTH,NELEM,NLINK,NZ,
     1NC,NSKIN,NINT,NSTBLTY,NCC)
      IF (NC.EQ.0) GO TO 87
      DO 86 L=1,NC
      KM=NMAT(L)
      DO 86 J=1,NZ
      SPWT=SPWTC(J,KM)
      IF (WEIGHT.LT.WMIN) AAEL(L,J)=AL(L,J)
      IF (WEIGHT.LT.WMIN) BLAST=BASEAE
      IF (NFULL.EQ.1) AL(L,J)=STRENG(L,J)
      IF (NFULL.EQ.1) GO TO 86
C     STRENG(L,J)=STRENG(L,J)/SPWT
      AL(L,J)=AL(L,J)*SQRT(STRENG(L,J))
 86   CONTINUE
 87   CONTINUE
      DO 88 L=1,NI
      K1=L+NC
      IF (WEIGHT.LT.WMIN) AAEI(L)=A(K1)
      KM=NMAT(K1)
      SPWT=SPWTT(KM)
      IF (NFULL.EQ.1) A(K1)=STNG(L)
      IF (NFULL.EQ.1) GO TO 88
C     STNG(L) =STNG(L)/SPWT
      A(K1)=A(K1)*SQRT(STNG(L))
 88   CONTINUE
      IF (WEIGHT.LT.WMIN) WMIN=WEIGHT
      NDUM=0
 89   CONTINUE
      DO 94 K=1,2
      CALL ANORM (A,AL,MEMBS,AMAX,NC,NZ,NCC)
      IF (NC.EQ.0) GO TO 91
      DO 90 I=1,NC
      AMIN=A(I)
      KM=NMAT(I)
      IF (AMIN*BASEAE.GT.BMAX(I)) A(I)=BMAX(I)/BASEAE
      IF (AMIN*BASEAE.LT.BMIN(I)) A(I)=BMIN(I)/BASEAE
      DO 90 J=1,NZ
      AL(I,J)=AL(I,J)*A(I)/AMIN
      THK1=THMIN(J,KM)
      IF (AL(I,J)*BASEA.LT.THK1) AL(I,J)=THK1/BASEA
 90   CONTINUE
 91   CONTINUE
      K1=NC+1
      DO 93 I=K1,MEMBS
```

```
      IF (LAST.GE.1) GO TO 92
      IF (NANEG(KK).GT.0) A(I)=ANEG(KK)/(AABAS*E1)
   92 CONTINUE
      IF (A(I)*BASEAE.LT.BMIN(I)) A(I)=BMIN(I)/BASEAE
      IF (A(I)*BASEAE.GT.BMAX(I)) A(I)=BMAX(I)/BASEAE
   93 CONTINUE
      CALL ANORM (A,AL,MEMBS,AMAX,NC,NZ,NCC)
   94 CONTINUE
      IF (LAST.GE.1) GO TO 44
      IF (NOLIS.EQ.1) GO TO 44
      IF (NDUM.EQ.1) GO TO 97
      WTLAST=WEIGHT
      KCOUNT=KCOUNT+1
      GO TO 44
   95 CONTINUE
      LAST=0
      IF (NSTBLTY.NE.0.AND.NSTBLTY.NE.LNSB) NZERO=1
      NCHK=1
      NFULL=0
      CALL MEMB (X,Y,Z,MA,MB,MC,MD,KTYPE,A,DR,STRENG,AL,ELENTH,SSTHK,ZAN
     1GLE,STNG,ENGL,NMAT,SSTRT,SSTRC,SSTRS,GSHE,AWIDE,BWIDE,ANEG,NANEG,P
     2ECT,NC,NZ,LOADS,NCC,NZK,NZERO)
      IF (NSTBLTY.GE.LNSB) GO TO 98
      IF (NSTBLTY.EQ.0) GO TO 98
      IF (LINK.EQ.1) CALL ALINK (A,AL,STRENG,STNG,ELENTH,NELEM,NLINK,NZ,
     1NC,NSKIN,NINT,NSTBLTY,NCC)
      K1=NC+1
      NOLIS=0
      NDUM=1
      NMZ=NC+1
      DO 96 L=NMZ,MEMBS
      KK=L-NC
      IF (NANEG(KK).GT.0) A(L)=ANEG(KK)/(AABAS*E1)
      IF (A(L)*BASEAE.LT.BMIN(L)) A(L)=BMIN(L)/BASEAE
      IF (A(L)*BASEAE.GT.BMAX(L)) A(L)=BMAX(L)/BASEAE
   96 CONTINUE
      GO TO 83
   97 CONTINUE
      NSTBLTY=NSTBLTY+1
      IF (NSTBLTY.EQ.LNSB) LAST=1
      IF (NSTBLTY.LE.LNSB) GO TO 44
   98 CONTINUE
      CALL PRNTOR (FR,DR,X,Y,Z,IBND,NN,MM,LOADS,JOINTS,NPAGE,NB,NZERO,NZ
     1K)
      IF (NC.EQ.0) GO TO 101
      DO 99 I=1,NC
      KM=NMAT(I)
      DO 99 J=1,NZ
      THKK=THEK(J,KM)
      ANLRS=AL(I,J)*BASEA/THKK
      NLYRS(I,J)=IFIX(ANLRS)+1
   99 CONTINUE
      WRITE (6,136)
      K1=1
      K2=5
      K3=NC/5+1
      DO 100 JKK=1,K3
```

```
      IF (K1.GT.NC) GO TO 100
      IF (K2.GT.NC) K2=NC
      IF (NZ.EQ.4) WRITE (6,137) ((I,(NLYRS(I,J),J=1,NZ)),I=K1,K2)
      IF (NZ.EQ.3) WRITE (6,138) ((I,(NLYRS(I,J),J=1,NZ)),I=K1,K2)
      K1=K1+5
      K2=K2+5
  100 CONTINUE
  101 CONTINUE
      DO 102 I=1,MEMBS
  102 A(I)=A(I)*BASEA
      WRITE (6,139)
      WRITE (6,140)
      K1=1
      K2=10
      K3=MEMBS/10+1
      DO 103 J=1,K3
      IF (K1.GT.MEMBS) GO TO 103
      IF (K2.GT.MEMBS) K2=MEMBS
      K4=J-1
      WRITE (6,141) K4,(A(I),I=K1,K2),K2
      K1=K1+10
      K2=K2+10
  103 CONTINUE
      DO 104 I=1,MEMBS
  104 A(I)=A(I)/BASEA
      LAST=0
      NSTBLTY=NSTBLTY+1
      IF (NSTBLTY.EQ.1) GO TO 44
      IF (NSTBLTY.GT.LNSB) MFORCE=1
      IF (MFORCE.EQ.1) GO TO 44
  105 CONTINUE
      IF (KSTR.EQ.NSTR) GO TO 106
      KSTR=KSTR+1
      GO TO 1
  106 CONTINUE
      ATIME=SECOND(AAZ)
      WRITE (6,146) ATIME
      STOP
C
  107 FORMAT (1HT)
  108 FORMAT (1H1)
  109 FORMAT (8A10)
  110 FORMAT (5X,11HPROBLEM NO=,I5,5X,8A10)
  111 FORMAT (5X,16I5)
  112 FORMAT (5X,8E10.4)
  113 FORMAT (4F20.4)
  114 FORMAT (5X,4F20.4)
  115 FORMAT (8E10.4)
  116 FORMAT (5X,8E10.4)
  117 FORMAT (5F15.4)
  118 FORMAT (5X,5F15.4)
  119 FORMAT (3E10.4)
  120 FORMAT (5X,3E10.4)
  121 FORMAT (I5,I3,I2,4I5,5E10.4)
  122 FORMAT (5X,I5,I3,I2,4I5,5E10.4)
  123 FORMAT (5X,I5,3E10.4)
  124 FORMAT (I5,3E10.4)
```

```
 125   FORMAT (16I5)                                                        MAIN
 126   FORMAT (8E10.4)                                                      MAIN
 127   FORMAT (5X,3(E10.4,2I5))                                             MAIN
 128   FORMAT (3(F10.4,2I5))                                                MAIN
 129   FORMAT (//,10X,44HINSUFFICIENT CORE TO STORE STIFFNESS MATRIX.,25H  MAIN
      1DIMENSION OF SK SHOULD BE,I15)                                       MAIN
 130   FORMAT (3X,/)                                                        MAIN
 131   FORMAT (2X,8E12.4,5X,2HCC)                                           MAIN
 132   FORMAT (1H0,10X,12HANALYSIS NO=,I5)                                  MAIN
 133   FORMAT (1H0,6HBASEA=,1PE15.5,11HDIFFERENCE=,1PE15.5)                 MAIN
 134   FORMAT (10X,9HELE SKIN=,I5,5X,6HABASE=,1E15.4,10X,11HELE STRUCT=,I  MAIN
      15,10X,6HCBASE=,1E15.4)                                               MAIN
 135   FORMAT (30X,21HMINIMUM WEIGHT CYCLE=,I5)                             MAIN
 136   FORMAT (//5X,39HNUMBER OF LAMINAE IN COMPOSITE ELEMENTS)             MAIN
 137   FORMAT (2X,(5(1H(,I3,1H),4I5,2X)))                                   MAIN
 138   FORMAT (2X,(5(1H(,I3,1H),3I5,2X)))                                   MAIN
 139   FORMAT (//5X,27HTOTAL THICKNESS OF ELEMENTS)                         MAIN
 140   FORMAT (1H0,18X,1H1,9X,1H2,9X,1H3,9X,1H4,9X,1H5,9X,1H6,9X,1H7,9X,1  MAIN
      1H8,9X,1H9,9X,1H0,//)                                                 MAIN
 141   FORMAT (3X,I5,4X,10E10.3,3X,I5)                                      MAIN
 142   FORMAT (5X,13HSTRUCTURE NO=,I5,9X,12HNO OF LOADS=,I5,10X,9HCYCLE N  MAIN
      1O=,I5,10X,12HEQ CYCLE NO=,I5,10X,8HNSTBLTY=,I5)                      MAIN
 143   FORMAT (1H ,10F12.6)                                                 MAIN
 144   FORMAT (//5X,25HRELATIVE AREAS OF MEMBERS)                           MAIN
 145   FORMAT (//,5X,12HWEIGHT-SKIN=,1PE14.6,5X,16HWEIGHT-S-PANELS=,1PE14  MAIN
      1.6,5X,13HWEIGHT-POSTS=,1PE14.6,5X,13HTOTAL-WEIGHT=,1PE14.6)          MAIN
 146   FORMAT (//2X,22HTIME USED IN SECONDS =,F10.4)                        MAIN
       END                                                                  MAIN
```

```
SUBROUTINE MEMB        74/74    OPT=1                          FTN 4.5+414         10/29/76  12.20.38         PAGE     1

      SUBROUTINE MEMB (X,Y,Z,MA,MB,MC,MD,KTYPE,TH,OR,STRENG,AL,ELENTH,SS MEMB      2
     1THK,ZANGLE,STNG,ENGL,NMAT,SSTRT,SSTRC,SSTRS,GSHE,AWIDE,BWIDE,ANEG, MEMB      3
     2NANEG,PECT,NC,NZ,LD,NCC,NN,NOPRNT)                                 MEMB      4
      COMMON /AA/ NEF,NAVG,NFULL,NCHK,NCRTIA,NSTBLTY,NLO,NFI,NZEO,NSTRN, MEMB      5
     1NFOR,NENG,NBLNCE,LAST,LNSB,ABAS,CBAS,LSKIN,LINT,MEMBS,MM,E1,BASEAE MEMB      6
     2,BASEA,NFIBER,LSTCOL,LCHEK                                         MEMB      7
      COMMON /BB/ MAA,MBB,MCC,EK,EKK,B,C,XI,ETA,ZI,XXI,YII,XD,YD,ZD,SSMA MEMB      8
     1X,THE,THETA,EKL,E,AEE,CC,AA,AAA,AE,AB,DA,EE,EO                     MEMB      9
C     DIMENSIONS OF THE VARIABLES NOT MEMTIONED IN THE COMMENT CARDS     MEMB     10
C     ARE UNCHANGED                                                      MEMB     11
C     EDR,EDDR,CDR,--(12,LOADS) NEEDS CHANGE IF LOADS IS GREATER THAN 10 MEMB     12
C     AX,AY,AXY,--(1,LOADS)                                ''            MEMB     13
C     SX,EX,EY,EXY,ELEENG,--(LOADS)   ''                   ''            MEMB     14
C     SSMAX,THE,THETA,E,AEE,CC,-- DIMENSIONS CONSISTENT WITH THOSE IN MAIN MEMB   15
C     SSX,SSY,SSXY,EFFSTR,ASX,ASY,ASXY,PX,PY,PXY,BSX,BSY,BSXY,EXFI,      MEMB     16
C     EYFI,EXYFI,--(4,LOADS,NZ)--NEEDS CHANGE ONLY IF LOADS IS GREATER   MEMB     17
C     THAN 10 AND NZ GREATER THAN 4                                      MEMB     18
C     ENGSTR,--(LOADS,NZ)$$$BL,--(1,NZ)$$$STHK,PRCT,--(NZ)$$$            MEMB     19
      DIMENSION X(1), Y(1), Z(1), MA(1), MB(1), MC(1), MD(1), KTYPE(1),  MEMB     20
     1TH(1), OR(NN,LD), STRENG(NCC,NZ), AL(NCC,NZ), ELENTH(1), SSTHK(NCC MEMB     21
     2,NZ), ZANGLE(1), STNG(1), ENGL(1), NMAT(1), SSTRT(1), SSTRS(1), GS MEMB     22
     3HE(1), AWIDE(1), BWIDE(1), PECT(1), NANEG(1), ANEG(1), SSTRC(1)    MEMB     23
      DIMENSION AA(3,3), AB(3), EK(12,12), XI(5), ETA(5), C(12,12), B(12 MEMB     24
     1,12), XX(3), YY(3), XXI(5), YII(5), ZI(5), EKK(12,12), AAA(3,3), M MEMB     25
     2AA(4), MBB(4), MCC(4), AE(3,3), EE(3,3), EO(3), EKL(12,12), DA(3,3 MEMB     26
     3), XD(3), YD(3), ZD(3), NCON(4)                                    MEMB     27
      DIMENSION EDR(12,10), EDDR(12,10), CDR(12,10), AX(1,10), AY(1,10), MEMB     28
     1 AXY(1,10), SX(10), EX(10), EY(10), EXY(10), ELEENG(10)            MEMB     29
      DIMENSION SSMAX(5,4,4), THE(4,3), THETA(4,3), E(4), AEE(9,4,4), CC MEMB     30
     1(9,4,4)                                                            MEMB     31
      DIMENSION SSX(4,10,4), SSY(4,10,4), SSXY(4,10,4), EFFSTR(4,10,4),  MEMB     32
     1ENGSTR(10,4), ASX(4,10,4), ASY(4,10,4), ASXY(4,10,4), PX(4,10,4),  MEMB     33
     2PY(4,10,4), PXY(4,10,4), BSX(4,10,4), BSY(4,10,4), BSXY(4,10,4), E MEMB     34
     3XFI(4,10,4), EYFI(4,10,4), EXYFI(4,10,4), BL(1,4), STHK(4), PRCT(4 MEMB     35
     4), TRANG(4), AD(3,3), A(3,3)                                       MEMB     36
      NZERO=0                                                            MEMB     37
      LLDS=LOADS                                                         MEMB     38
      IF (NENG.EQ.3.OR.NENG.EQ.4) LLDS=1                                 MEMB     39
      NI=MEMBS-NC                                                        MEMB     40
      IL1=NZ-1                                                           MEMB     41
      IL2=NZ                                                             MEMB     42
      LOADS=LD                                                           MEMB     43
      NON=1                                                              MEMB     44
      NTO=2                                                              MEMB     45
      NTH=3                                                              MEMB     46
      CBASE=0.0                                                          MEMB     47
      CBAS=0.0                                                           MEMB     48
      TBAS=BASEA                                                         MEMB     49
      TBASE=BASEAE                                                       MEMB     50
      ABASE=0.0                                                          MEMB     51
      ABAS=0.0                                                           MEMB     52
      NTW=12                                                             MEMB     53
      DO 1 I=1,NC                                                        MEMB     54
      DO 1 J=1,NZ                                                        MEMB     55
    1 STRENG(I,J)=0.0                                                    MEMB     56
      DO 2 I=1,NI                                                        MEMB     57
    2 STNG(I)=0.0                                                        MEMB     58
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      DO 106 L=1,MEMBS                                                  MEMB      59
      KM=NMAT(L)                                                        MEMB      60
      BASEA=TBAS                                                        MEMB      61
      BASEAE=TBASE                                                      MEMB      62
      KNODE=4                                                           MEMB      63
      IF (KTYPE(L).LE.4) KNODE=KTYPE(L)                                 MEMB      64
      IF (NOPRNT.EQ.1) GO TO 3                                          MEMB      65
      IF (L.EQ.1) WRITE (6,126)                                         MEMB      66
    3 CONTINUE                                                          MEMB      67
      NCON(1)=MM*(MA(L)-1)+1                                            MEMB      68
      NCON(2)=MM*(MB(L)-1)+1                                            MEMB      69
      IF (KNODE.GE.3) NCON(3)=MM*(MC(L)-1)+1                            MEMB      70
      IF (KNODE.GE.4) NCON(4)=MM*(MD(L)-1)+1                            MEMB      71
      NDSP=1                                                            MEMB      72
      IF (KNODE.GT.2) NDSP=2                                            MEMB      73
      CALL COORD (MA(L),MB(L),MC(L),MD(L),X,Y,Z,AA,XI,ETA,PL,KNODE,NZERO MEMB      74
     1,AB)                                                              MEMB      75
      IF (L.GT.NC) GO TO 4                                              MEMB      76
      IF (NFIBER.EQ.1) PANGLE=ZANGLE(L)                                 MEMB      77
      CALL AVECT (X0,Y0,Z0,THE,AA,THETA,NZ,PANGLE,NFIBER)               MEMB      78
    4 CONTINUE                                                          MEMB      79
      DO 5 J=1,NZ                                                       MEMB      80
    5 PRCT(J)=0.0                                                       MEMB      81
      DO 6 J=1,LOADS                                                    MEMB      82
      DO 6 JL=1,NZ                                                      MEMB      83
    6 ENGSTR(J,JL)=0.0                                                  MEMB      84
      DO 8 K=1,LOADS                                                    MEMB      85
      KH=1                                                              MEMB      86
      DO 8 KK=1,KNODE                                                   MEMB      87
      DO 8 I=1,NDSP                                                     MEMB      88
      KX=NCON(KK)                                                       MEMB      89
      EDR(KH,K)=0                                                       MEMB      90
      DO 7 J=1,MM                                                       MEMB      91
    7 EDR(KH,K)=EDR(KH,K)+AA(I,J)*DR(KX,K)                              MEMB      92
      KX=KX+1                                                           MEMB      93
    8 KH=KH+1                                                           MEMB      94
      DO 10 K=1,LOADS                                                   MEMB      95
      LK=1                                                              MEMB      96
      DO 10 KK=1,KNODE                                                  MEMB      97
      KX=NCON(KK)                                                       MEMB      98
      DO 9 J=1,MM                                                       MEMB      99
      CDR(LK,K)=DR(KX,K)                                                MEMB     100
      LK=LK+1                                                           MEMB     101
    9 KX=KX+1                                                           MEMB     102
   10 CONTINUE                                                          MEMB     103
      IF (KTYPE(L).EQ.2) GO TO 81                                       MEMB     104
      IF (KTYPE(L).EQ.5) GO TO 71                                       MEMB     105
      DO 11 I=1,12                                                      MEMB     106
      DO 11 J=1,12                                                      MEMB     107
   11 EK(I,J)=0.                                                        MEMB     108
      QUAD=0.                                                           MEMB     109
      NT=4                                                              MEMB     110
      IF (KTYPE(L).EQ.3) NT=1                                           MEMB     111
      NTRI=NT                                                           MEMB     112
      DO 20 I=1,NT                                                      MEMB     113
      IF (NT.EQ.4) GO TO 13                                             MEMB     114
      DO 12 J1=1,3                                                      MEMB     115
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      XXI(J1)=XI(J1)                                                    MEMB     116
      YII(J1)=ETA(J1)                                                   MEMB     117
      DO 12 I1=1,3                                                      MEMB     118
      AAA(I1,J1)=0.0                                                    MEMB     119
   12 CONTINUE                                                          MEMB     120
      AAA(1,1)=1.0                                                      MEMB     121
      AAA(2,2)=1.0                                                      MEMB     122
      GO TO 14                                                          MEMB     123
   13 CONTINUE                                                          MEMB     124
      CALL CCORD (MAA(I),MBB(I),MCC(I),MD(I),XI,ETA,ZI,AAA,XXI,YII,PL,NT MEMB     125
     1H,NZERO,AB)                                                       MEMB     126
   14 CONTINUE                                                          MEMB     127
      DO 15 JK=1,6                                                      MEMB     128
      DO 15 IK=1,6                                                      MEMB     129
   15 EKK(IK,JK)=0.0                                                    MEMB     130
      DO 19 IL=1,NZ                                                     MEMB     131
      THK=AL(L,IL)                                                      MEMB     132
      DO 16 KL=1,3                                                      MEMB     133
   16 EO(KL)=THETA(IL,KL)                                               MEMB     134
      JK=0                                                              MEMB     135
      DO 17 J1=1,3                                                      MEMB     136
      DO 17 K1=1,3                                                      MEMB     137
      JK=JK+1                                                           MEMB     138
   17 AE(J1,K1)=AEE(JK,IL,KM)                                           MEMB     139
      CALL ELAS (AAA,AB,AE,EO,DA,EE)                                    MEMB     140
      CALL COMF (EKL,THK,TRIANG,XXI,YII,EE)                             MEMB     141
      DO 18 IK=1,6                                                      MEMB     142
      DO 18 JK=1,6                                                      MEMB     143
   18 EKK(IK,JK)=EKK(IK,JK)+EKL(IK,JK)                                  MEMB     144
   19 CONTINUE                                                          MEMB     145
      TRANG(I)=TRIANG                                                   MEMB     146
      QUAD=QUAD+TRIANG                                                  MEMB     147
      IF (NT.EQ.1) GO TO 20                                             MEMB     148
      CALL TRVSFM (EKK,AAA,B,C,NTO,NTH,NTW)                             MEMB     149
      CALL SUM (EK,C,MAA(I),MBB(I),MCC(I))                              MEMB     150
   20 CONTINUE                                                          MEMB     151
      ELENTH(L)=QUAD                                                    MEMB     152
      IF (NT.EQ.1) GO TO 25                                             MEMB     153
      DO 21 I=1,10                                                      MEMB     154
      DO 21 J=1,10                                                      MEMB     155
   21 EKL(I,J)=EK(I,J)                                                  MEMB     156
      NON=1                                                             MEMB     157
      CALL CONDNS (EK,EKK,MA(L),MB(L),MC(L),MD(L),NON)                  MEMB     158
      DO 23 K=1,LOADS                                                   MEMB     159
      KX=0                                                              MEMB     160
      DO 23 I=9,10                                                      MEMB     161
      KX=KX+1                                                           MEMB     162
      EDR(I,K)=0.                                                       MEMB     163
      DO 22 J=1,8                                                       MEMB     164
   22 EDR(I,K)=EDR(I,K)+EKK(KX,J)*EDR(J,K)                              MEMB     165
      EDR(I,K)=-EDR(I,K)                                                MEMB     166
   23 CONTINUE                                                          MEMB     167
      DO 24 K=1,LOADS                                                   MEMB     168
      EDDR(5,K)=EDR(9,K)                                                MEMB     169
   24 EDDR(6,K)=EDR(10,K)                                               MEMB     170
      XX(3)=XI(5)                                                       MEMB     171
      YY(3)=ETA(5)                                                      MEMB     172
```

```
      KX=1
      KY=3
   25 CONTINUE
      DO 42 I=1,NT
      XX(1)=XI(I)
      YY(1)=ETA(I)
      XX(2)=XI(I+1)
      YY(2)=ETA(I+1)
      IF (NT.EQ.4) GO TO 28
      XX(3)=XI(I+2)
      YY(3)=ETA(I+2)
      DO 26 I1=1,LO
      DO 26 J1=1,6
   26 EDOR(J1,I1)=EDR(J1,I1)
      DO 27 I1=1,6
      DO 27 J1=1,6
   27 EK(I1,J1)=EKK(I1,J1)
      GO TO 32
   28 CONTINUE
      IF (I.LT.4) GO TO 29
      XX(2)=XI(1)
      YY(2)=E(  (1)
      KX=7
      KY=1
   29 DO 31 J=1,2
      DO 30 K=1,LOADS
      EDOR(J,K)=EDR(KX,K)
   30 EDOR(J+2,K)=EDR(KY,K)
      KX=KX+1
   31 KY=KY+1
   32 CONTINUE
      CALL STRAIN (EDOR,XX,YY,EX,EY,EXY,LOADS,TRI)
      TRANG(I)=TRI
      IF (NT.EQ.4) GO TO 34
      DO 33 I1=1,3
      DO 33 J1=1,3
   33 AAA(I1,J1)=0.0
      AAA(1,1)=1.0
      AAA(2,2)=1.0
      GO TO 35
   34 CONTINUE
      IF (I.GT.1) GO TO 35
      CALL COORD (MAA(I),MBB(I),MCC(I),MD(I),XI,ETA,ZI,AAA,XXI,YII,PL,NT
     1H,NZERO,AB)
   35 CONTINUE
      DO 41 IL=1,NZ
      DO 36 KL=1,3
   36 EO(KL)=THETA(IL,KL)
      JK=0
      DO 37 J1=1,3
      DO 37 K1=1,3
      JK=JK+1
   37 AE(J1,K1)=AED(JK,IL,KM)
      CALL ELAS (A1A,AB,AE,EO,DA,EE)
      IF (IL.EQ.1) GO TO 38
      GO TO 40
   38 DO 39 IK=1,3
```

```
      DO 39 J=1,3
   39 AD(IK,J)=DA(IK,J)                                              MEMB 230
   40 CONTINUE                                                       MEMB 231
      CALL STRES (EE,E1,EX,EY,EXY,SSX,SSY,SSXY,ASX,ASY,ASXY,EXFI,EYFI,EX MEMB 232
     1YFI,BSX,BSY,BSXY,DA,AD,LOADS,I,IL)                             MEMB 233
   41 CONTINUE                                                       MEMB 234
   42 CONTINUE                                                       MEMB 235
      IF (NT.EQ.1) GO TO 43                                          MEMB 236
      CALL AVSTRS (EXFI,TRANG,QUAD,LOADS,NZ)                         MEMB 237
      CALL AVSTRS (EYFI,TRANG,QUAD,LOADS,NZ)                         MEMB 238
      CALL AVSTRS (EXYFI,TRANG,QUAD,LOADS,NZ)                        MEMB 239
      CALL AVSTRS (SSX,TRANG,QUAD,LOADS,NZ)                          MEMB 240
      CALL AVSTRS (SSY,TRANG,QUAD,LOADS,NZ)                          MEMB 241
      CALL AVSTRS (SSXY,TRANG,QUAD,LOADS,NZ)                         MEMB 242
      CALL AVSTRS (ASX,TRANG,QUAD,LOADS,NZ)                          MEMB 243
      CALL AVSTRS (ASY,TRANG,QUAD,LOADS,NZ)                          MEMB 244
      CALL AVSTRS (ASXY,TRANG,QUAD,LOADS,NZ)                         MEMB 245
      CALL AVSTRS (BSX,TRANG,QUAD,LOADS,NZ)                          MEMB 246
      CALL AVSTRS (BSY,TRANG,QUAD,LOADS,NZ)                          MEMB 247
      CALL AVSTRS (BSXY,TRANG,QUAD,LOADS,NZ)                         MEMB 248
      NT=1                                                           MEMB 249
      TRI=QUAD                                                       MEMB 250
      TRANG(1)=QUAD                                                  MEMB 251
   43 CONTINUE                                                       MEMB 252
      IF (NCRTIA.NE.2) CALL ENGS (SSMAX,BSX,BSY,BSXY,PX,PY,PXY,EXFI,EYFI MEMB 253
     1,EXYFI,ENGSTR,EFFSTR,LOADS,NZ,KM,NCRTIA,NENG,NEF)              MEMB 254
      IF (NCRTIA.EQ.2) CALL ENGS (SSMAX,EXFI,EYFI,EXYFI,PX,PY,PXY,BSX,BS MEMB 255
     1Y,BSXY,ENGSTR,EFFSTR,LOADS,NZ,KM,NCRTIA,NENG,NEF)              MEMB 256
      DO 44 J=1,NZ                                                   MEMB 257
   44 PRCT(J)=AL(L,J)/TH(L)                                          MEMB 258
      NTRI=NT                                                        MEMB 259
      IF (LCHEK.EQ.0.AND.LSTCCL.EQ.0) GO TO 54                       MEMB 260
      IF (NCRTIA.EQ.1.OR.NCRTIA.EQ.2) CALL SUGO (PX,PY,PXY,LOADS,BASEAE, MEMB 261
     1LLOD,LCRI,LLYR,NZ,STHK,SSMAX)                                  MEMB 262
      IF (NCRTIA.EQ.3.OR.NCRTIA.EQ.4) CALL SHILL (EFFSTR,LOADS,BASEAE,LL MEMB 263
     1OD,LCRI,LLYR,NZ,STHK)                                          MEMB 264
      BASEA=BASEAE/E1                                                MEMB 265
      RBASEA=BASEA/TBAS                                              MEMB 266
      IF (LCHEK.GT.0.AND.RBASEA.GT.1) WRITE (6,107) L,RBASEA,LLOD,LCRI,L MEMB 267
     1LYR                                                            MEMB 268
      IF (LSTCCL.EQ.0) GO TO 54                                      MEMB 269
      DO 45 J=1,NZ                                                   MEMB 270
   45 SSTHK(L,J)=STHK(J)*AL(L,J)                                     MEMB 271
      IF (NENG.EQ.3) GO TO 46                                        MEMB 272
      IF (NENG.EQ.4) GO TO 49                                        MEMB 273
      GO TO 51                                                       MEMB 274
   46 DO 48 II=1,NZ                                                  MEMB 275
      AMAX=0.0                                                       MEMB 276
      DO 47 KK=1,LOADS                                               MEMB 277
      IF (AMAX.LT.ENGSTR(KK,II)) AMAX=ENGSTR(KK,II)                  MEMB 278
   47 CONTINUE                                                       MEMB 279
      ENGSTR(1,II)=AMAX                                              MEMB 280
   48 CONTINUE                                                       MEMB 281
      GO TO 51                                                       MEMB 282
   49 DO 50 J=1,NZ                                                   MEMB 283
```

```
      IF (NBLICE.EQ.0) GO TO 53
      IF (IL1.LE.0) GO TO 53
      DO 52 J=1,LLDS
      ENGSTR(J,IL1)=(ENGSTR(J,IL1)+ENGSTR(J,IL2))/2.
      ENGSTR(J,IL2)=ENGSTR(J,IL1)
   52 CONTINUE
   53 CONTINUE
      IF (LAST.EQ.0) GO TO 54
      WRITE (6,107) L,BASEA,LLOD,LCRI,LLYR,(PRCT(J),J=1,NZ)
   54 CONTINUE
      IF (NOPRNT.EQ.1) GO TO 90
      CALL BFORCE (PRCT,AX,AY,AXY,ASX,ASY,ASXY,NZ,LOADS)
      IF (KTYPE(L).EQ.3) GO TO 55
      NTH=3
      CALL CONONS (EKL,EKK,MA(L),MB(L),MC(L),MD(L),NTH)
   55 CONTINUE
      NT1=2*KTYPE(L)
      DO 56 I=1,NT1
      DO 56 J=1,NT1
      IF (KTYPE(L).EQ.3) EK(I,J)=EK(I,J)*BASEAE
      IF (KTYPE(L).EQ.4) EK(I,J)=EKL(I,J)*BASEAE
   56 CONTINUE
      IF (NFOR.EQ.1) GO TO 59
      NTW=12
      CALL TRNSFM (EK,AA,B,C,MM,KNODE,NTW)
      NT1=MM*KNODE
      DO 57 I=1,NT1
      DO 57 J=1,NT1
      EK(I,J)=C(I,J)
   57 CONTINUE
      DO 58 K=1,LOADS
      DO 58 I=1,NT1
      EDR(I,K)=CDR(I,K)
   58 CONTINUE
   59 CONTINUE
      DO 61 K=1,LOADS
      DO 60 I=1,NT1
      EDDR(I,K)=0.0
      DO 60 J=1,NT1
      EDDR(I,K)=EDDR(I,K)+EK(I,J)*EDR(J,K)
   60 CONTINUE
   61 CONTINUE
      WRITE (6,110)
      DO 62 I=1,NZ
   62 BL(1,I)=AL(L,I)*BASEA
      THKK=TH(L)*BASEA
      WRITE (6,111) L,MA(L),MB(L),MC(L),MD(L),TRI,THKK,(BL(1,I),I=1,NZ)
      IF (NAVG.EQ.0) GO TO 63
      WRITE (6,112)
      WRITE (6,113) ((J,AX(1,J),AY(1,J),AXY(1,J)),J=1,LOADS)
   63 CONTINUE
      IF (NLC.EQ.0) GO TO 64
      WRITE (6,114)
      WRITE (6,115) (J,(IL,SSX(1,J,IL),SSY(1,J,IL),SSXY(1,J,IL),IL=1,NZ)
     1,J=1,LOADS)
```

```
      WRITE (6,116)
      WRITE (6,115) (J,(IL,BSX(1,J,IL),BSY(1,J,IL),BSXY(1,J,IL),IL=1,NZ)
     1,J=1,LOADS)
   65 CONTINUE
      IF (NZEJ.EQ.0) GO TO 66
      WRITE (6,117)
      WRITE (6,115) (J,(IL,ASX(1,J,IL),ASY(1,J,IL),ASXY(1,J,IL),IL=1,NZ)
     1,J=1,LOADS)
   66 CONTINUE
      IF (NSTRN.EQ.0) GO TO 67
      WRITE (6,118)
      WRITE (6,115) (J,(IL,EXFI(1,J,IL),EYFI(1,J,IL),EXYFI(1,J,IL),IL=1,
     1NZ),J=1,LOADS)
   67 CONTINUE
      IF (NEF.EQ.0) GO TO 68
      WRITE (6,119)
      WRITE (6,115) (J,(IL,EFFSTR(1,J,IL),IL=1,NZ),J=1,LOADS)
   68 CONTINUE
      IF (NFOR.EQ.0) GO TO 70
      WRITE (6,120)
      DO 69 J=1,LOADS
   69 WRITE (6,109) J,(EDDR(I,J),I=1,NT1)
   70 CONTINUE
      GO TO 90
   71 CONTINUE
      CALL SSRS (EDR,XI,ETA,TH(L),DET,SX,GSHE(KM),LOADS,ELEENG)
      ELENTH(L)=DET
      IF (LCHEK.EQ.0.AND.LSTOCL.EQ.0) GO TO 72
      CALL SURFACE (SX,BASEAE,SSTRS(KM),SSTRS(KM),LOADS,STHK,LLOD)
      BASEA=BASEAE/E1
      RBASEA=BASEA/TBAS
      IF (LCHEK.GT.0.AND.RBASEA.GT.1) WRITE (6,125) L,RBASEA,LLOD
      IF (LSTOCL.EQ.0) GO TO 73
      IF (NCHK.EQ.1) GO TO 72
      K1=L-NC
      NANEG(K1)=0
      IF (BASEAE.GT.ABASE) NANEG(K1)=1
      ANEG(K1)=STHK(1)*TH(L)
   72 CONTINUE
      IF (LAST.EQ.1) WRITE (6,125) L,BASEA,LLOD
   73 CONTINUE
      IF (NOPRNT.EQ.1) GO TO 95
      THKK=TH(L)*BASEA
      WRITE (6,121) L,MA(L),MB(L),MC(L),MD(L),DET,THKK
      WRITE (6,122)
      WRITE (6,123) (I,SX(I),I=1,LOADS)
      IF (NFOR.EQ.0) GO TO 95
      CALL SCOMP (EK,TH(L),QUAD,XI,ETA,GSHE(KM),E1)
      DO 74 I=1,8
      DO 74 J=1,8
   74 EK(I,J)=EK(I,J)*BASEAE
      NT1=8
      IF (NFOR.EQ.1) GO TO 77
      NTW=12
```

```
      DO 75 I=1,NT1
      DO 75 J=1,NT1
      EK(I,J)=C(I,J)
   75 CONTINUE
      DO 76 K=1,LOADS
      DO 76 I=1,NT1
   76 EDR(I,K)=COR(I,K)
   77 CONTINUE
      DO 79 K=1,LOADS
      DO 78 I=1,NT1
      EDDR(I,K)=0.0
      DO 78 J=1,NT1
      EDDR(I,K)=EDDR(I,K)+EK(I,J)*EDR(J,K)
   78 CONTINUE
   79 CONTINUE
      WRITE (6,108)
      DO 80 J=1,LOADS
   80 WRITE (6,109) J,(EDDR(I,J),I=1,NT1)
      GO TO 95
   81 CALL ELSTRS (EDR,AA,PL,SX,E(KM),LOADS,FLEENG)
      ELENTH(L)=PL
      IF (LCHEK.EQ.0.AND.LSTCCL.EQ.0) GO TO 83
      CALL SURFACE (SX,BASEAE,SSTRT(KM),SSTRC(KM),LOADS,STHK,LLOD)
      BASEA=BASEAE/E1
      RBASEA=BASEA/TBAS
      IF (LCHEK.GT.0.AND.RBASEA.GT.1) WRITE (6,125) L,RBASEA,LLOD
      IF (LSTCCL.EQ.0) GO TO 83
      IF (NCHK.EQ.1) GO TO 82
      K1=L-NC
      NANEG(K1)=0
      IF (BASEAE.GT.ABASE) NANEG(K1)=1
      ANEG(K1)=STHK(1)*TH(L)
   82 CONTINUE
   83 CONTINUE
      IF (LAST.EQ.1) WRITE (6,125) L,BASEA,LLOD
      IF (NOPRNT.EQ.1) GO TO 95
      THKK=TH(L)*BASEA
      WRITE (6,124) L,MA(L),MB(L),PL,THKK
      WRITE (6,122)
      WRITE (6,123) (I,SX(I),I=1,LOADS)
      IF (NFOR.EQ.0) GO TO 95
      DO 84 J=1,LOADS
      EDDR(1,J)=(EDR(1,J)-EDR(2,J))*BASEAE/PL
      EDDR(1,J)=EDDR(1,J)*TH(L)
   84 EDDR(2,J)=-EDDR(1,J)
      NT1=2
      IF (NFOR.EQ.1) GO TO 88
      CALL ELSTIF (AA,B,C,TH(L),MM,PL,E(KM),E1)
      NT1=MM*2
      DO 85 I=1,NT1
      DO 85 J=1,NT1
   85 EK(I,J)=C(I,J)*BASEAE
      DO 87 K=1,LOADS
      DO 86 I=1,NT1
      EDDR(I,K)=0.0
```

```
   87 CONTINUE                                                 MEMB  458
   88 CONTINUE                                                 MEMB  459
      WRITE (6,120)                                            MEMB  460
      DO 89 J=1,LOADS                                          MEMB  461
   89 WRITE (6,109) J,(EDOR(I,J),I=1,NT1)                      MEMB  462
      GO TO 95                                                 MEMB  463
   90 CONTINUE                                                 MEMB  464
      IF (ABASE.GT.BASEAE) GO TO 91                            MEMB  465
      LSKIN=L                                                  MEMB  466
      ABASE=BASEAE                                             MEMB  467
      ABAS=BASEA                                               MEMB  468
   91 CONTINUE                                                 MEMB  469
      IF (NSTBLTY.EQ.0) GO TO 101                              MEMB  470
      IF (NSTBLTY.GE.LNSB) GO TO 106                           MEMB  471
      IF (NCHK.EQ.0) GO TO 101                                 MEMB  472
      JK=0                                                     MEMB  473
      DO 93 I=1,3                                              MEMB  474
      DO 93 J=1,3                                              MEMB  475
      A(I,J)=0.0                                               MEMB  476
      JK=JK+1                                                  MEMB  477
      THK=0.0                                                  MEMB  478
      DO 92 K=1,NZ                                             MEMB  479
      A(I,J)=A(I,J)+CC(JK,K,KM)*AL(L,K)*BASEA                  MEMB  480
      THK=AL(L,K)*BASEA+THK                                    MEMB  481
   92 CONTINUE                                                 MEMB  482
      A(I,J)=A(I,J)/THK                                        MEMB  483
   93 CONTINUE                                                 MEMB  484
      CALL BFORCE (PRCT,AX,AY,AXY,ASX,ASY,ASXY,NZ,LOADS)       MEMB  485
      CALL SBUCKL (A,AX,AY,AXY,THK,LOADS,AWIDE(L),BWIDE(L),THAX) MEMB  486
      TDIFF=(TMAX-THK)/BASEA*0.7                               MEMB  487
      IF (TDIFF.LT.0.) GO TO 106                               MEMB  488
      DO 94 I=1,NZ                                             MEMB  489
   94 AL(L,I)=AL(L,I)+PECT(I)*TDIFF                            MEMB  490
      GO TO 106                                                MEMB  491
   95 CONTINUE                                                 MEMB  492
      IF (NSTBLTY.NE.0) GO TO 105                              MEMB  493
      DO 100 J=1,LLDS                                          MEMB  494
      GO TO (96,97,99,99), NENG                                MEMB  495
   96 ENGSTR(J,1)=ELEENG(J)                                    MEMB  496
      GO TO 100                                                MEMB  497
   97 CONTINUE                                                 MEMB  498
      IF (KTYPE(L).EQ.2) GO TO 98                              MEMB  499
      ENGSTR(J,1)=ELEENG(J)/(SSTRS(KM)**2/GSHE(KM))            MEMB  500
      GO TO 100                                                MEMB  501
   98 SSTRI=SSTRT(KM)                                          MEMB  502
      IF (SX(J).LT.0.) SSTRI=SSTRC(KM)                         MEMB  503
```

```
      IF (NFULL.EQ.1) STRENG(L,K)=AL(L,K)*BASEA
  102 CONTINUE                                                         MEMB    515
      GO TO 106                                                         MEMB    516
  103 CONTINUE                                                         MEMB    517
      K1=L-NC                                                           MEMB    518
      DO 104 J=1,LLDS                                                   MEMB    519
      STNG(K1)=STNG(K1)+ENGSTR(J,1)                                     MEMB    520
      IF (NFULL.EQ.1) STNG(K1)=TH(L)*BASEA                              MEMB    521
  104 CONTINUE                                                         MEMB    522
  105 CONTINUE                                                         MEMB    523
      IF (CBASE.GT.BASEAE) GO TO 106                                    MEMB    524
      LINT=L                                                            MEMB    525
      CBASE=BASEAE                                                      MEMB    526
      CBAS=BASEA                                                        MEMB    527
  106 CONTINUE                                                         MEMB    528
      BASEAE=AMAX1(CBASE,ABASE)                                         MEMB    529
      BASEA=AMAX1(CBAS,ABAS)                                            MEMB    530
      IF (LSTCCL.EQ.0) BASEA=TBAS                                       MEMB    531
      IF (LSTCCL.EQ.0) BASEAE=TBASE                                     MEMB    532
      RETURN                                                            MEMB    533
C                                                                       MEMB    534
  107 FORMAT (2X,2HL=,I5,2X,6HBASEA=,1E12.5,2X,4HL-C=,I2,2X,4HCFI=,I2,2X MEMB    535
     1,4HLAR=,I3,2X,6HPRCNT=,9F8.3)                                     MEMB    536
  108 FORMAT (10X,12HNODAL FORCES)                                      MEMB    537
  109 FORMAT (1X,I2,12E11.4)                                            MEMB    538
  110 FORMAT (3X//)                                                     MEMB    539
  111 FORMAT (2X,4HMEMB,I5,2X,5HNODES,4I5,2X,4HAREA,1E10.4,2X,5HTHICK,1E MEMB    540
     19.4,2X,12HLAYER(THICK),4E10.4)                                    MEMB    541
  112 FORMAT (2X,33HAVERAGE STRESSES (ZERO FIBER DIRECTION))            MEMB    542
  113 FORMAT (1X,I2,2X,3E10.4)                                          MEMB    543
  114 FORMAT (2X,48HSTRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES))   MEMB    544
  115 FORMAT ((1H ,I2,4(I2,1X,3E10.4)))                                 MEMB    545
  116 FORMAT (2X,47HSTRESSES IN INDIVIDUAL LAYERS(FIBER DIRECTIONS))    MEMB    546
  117 FORMAT (2X,51HSTRESSES IN INDIVIDUAL LAYERS(ZERO FIBER DIRECTION)) MEMB   547
  118 FORMAT (2X,45HSTRAINS IN INDIVIDUAL LAYERS(FIBER DIRECTION))      MEMB    548
  119 FORMAT (2X,16HEFFECTIVE STRESS)                                   MEMB    549
  120 FORMAT (2X,12HNODAL FORCES)                                       MEMB    550
  121 FORMAT (2X,4HMEMB,I5,2X,5HNODES,4I5,2X,4HAREA,1E10.4,2X,5HTHICK,1E MEMB    551
     110.4)                                                             MEMB    552
  122 FORMAT (2X,8HSTRESSES)                                            MEMB    553
  123 FORMAT ((1H ,8(I2,1X,1E10.4)))                                    MEMB    554
  124 FORMAT (2X,4HMEMB,I5,2X,5HNODES,2I5,2X,6HLENGTH,1E10.4,2X,4HAREA,1 MEMB    555
     1E10.4)                                                            MEMB    556
  125 FORMAT (2X,2HL=,I5,2X,6HBASEA=,1E12.5,2X,4HL-C=,I2)               MEMB    557
  126 FORMAT (1H1,48X,25H*****S T R E S S E S*****,///)                 MEMB    558
      END                                                               MEMB    559
                                                                        MEMB    560
```

CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

```
      SUBROUTINE SUGD (FX,PY,PXY,LOADS,BASEAE,LLOD,LCRI,LLYR,NZ,STHK,SSM SUGD     2
     1AX)                                                               SUGD     3
C  DIMENSIONS OF PX,PY,PXY,SSMAX CONSISTENT WITH THOSE IN MEMB          SUGD     4
C  SUBROUTINE                                                           SUGD     5
      DIMENSION PX(4,10,4), PY(4,10,4), PXY(4,10,4), SSMAX(5,4,4)       SUGD     6
      DIMENSION STHK(1)                                                 SUGD     7
      LLOD=0                                                            SUGD     8
      LLYR=0                                                            SUGD     9
      LCRI=0                                                            SUGD    10
      AMAX=0                                                            SUGD    11
      STRSS=BASEAE                                                      SUGD    12
      I=1                                                               SUGD    13
      DO 4 J=1,LOADS                                                    SUGD    14
      DO 4 K=1,NZ                                                       SUGD    15
      IF (PX(I,J,K).LT.AMAX) GO TO 1                                    SUGD    16
      AMAX=PX(I,J,K)                                                    SUGD    17
      LLOD=J                                                            SUGD    18
      LLYR=K                                                            SUGD    19
      LCRI=1                                                            SUGD    20
    1 CONTINUE                                                          SUGD    21
      IF (PY(I,J,K).LT.AMAX) GO TO 2                                    SUGD    22
      AMAX=PY(I,J,K)                                                    SUGD    23
      LLOD=J                                                            SUGD    24
      LLYR=K                                                            SUGD    25
      LCRI=2                                                            SUGD    26
    2 CONTINUE                                                          SUGD    27
      IF (PXY(I,J,K).LT.AMAX) GO TO 3                                   SUGD    28
      AMAX=PXY(I,J,K)                                                   SUGD    29
      LLOD=J                                                            SUGD    30
      LLYR=K                                                            SUGD    31
      LCRI=3                                                            SUGD    32
    3 CONTINUE                                                          SUGD    33
    4 CONTINUE                                                          SUGD    34
      IF (STRSS.GE.AMAX) GO TO 5                                        SUGD    35
      RATIO=AMAX/STRSS                                                  SUGD    36
      BASEAE=BASEAE*RATIO                                               SUGD    37
    5 CONTINUE                                                          SUGD    38
      DO 10 K=1,NZ                                                      SUGD    39
      AMAX=0.0                                                          SUGD    40
      I=1                                                               SUGD    41
      DO 9 J=1,LOADS                                                    SUGD    42
      IF (PX(I,J,K).LT.AMAX) GO TO 6
```

```
          SUBROUTINE AVECT (XD,YD,ZD,THE,AA,THETA,NZ,PANGLE,NFIBER)         AVECT      2
C   DIMENSIONS OF THE, THETA CONSISTENT WITH THOSE IN MEMB SUBROUTINE       AVECT      3
          DIMENSION XD(3), YD(3), ZD(3), THE(4,3), AA(3,3), THETA(4,3)      AVECT      4
          EN1=AA(1,2)*AA(2,3)-AA(2,2)*AA(1,3)                               AVECT      5
          EN2=AA(1,3)*AA(2,1)-AA(1,1)*AA(2,3)                               AVECT      6
          EN3=AA(1,1)*AA(2,2)-AA(1,2)*AA(2,1)                               AVECT      7
          IF (NFIBER.EQ.0) GO TO 1                                          AVECT      8
          F1=COS(PANGLE)                                                    AVECT      9
          F2=SIN(PANGLE)                                                    AVECT     10
          F3=0.0                                                            AVECT     11
          G1=EN2*F3-EN3*F2                                                  AVECT     12
          G2=EN3*F1-EN1*F3                                                  AVECT     13
          ASIGN=1.                                                          AVECT     14
          GO TO 2                                                           AVECT     15
    1     CONTINUE                                                          AVECT     16
          F1=XD(2)-XD(1)                                                    AVECT     17
          F2=YD(2)-YD(1)                                                    AVECT     18
          F3=ZD(2)-ZD(1)                                                    AVECT     19
          AL=SQRT(F1**2+F2**2+F3**2)                                        AVECT     20
          F1=F1/AL                                                          AVECT     21
          F2=F2/AL                                                          AVECT     22
          F3=F3/AL                                                          AVECT     23
          G1=XD(3)-XD(1)                                                    AVECT     24
          G2=YD(3)-YD(1)                                                    AVECT     25
          G3=ZD(3)-ZD(1)                                                    AVECT     26
          AL=SQRT(G1**2+G2**2+G3**2)                                        AVECT     27
          G1=G1/AL                                                          AVECT     28
          G2=G2/AL                                                          AVECT     29
          G3=G3/AL                                                          AVECT     30
          FN1=F2*G3-F3*G2                                                   AVECT     31
          FN2=F3*G1-F1*G3                                                   AVECT     32
          FN3=F1*G2-F2*G1                                                   AVECT     33
          TN=EN1*F1+EN2*F2+EN3*F3                                           AVECT     34
          TD=EN1*FN1+EN2*FN2+EN3*FN3                                        AVECT     35
          TT=-TN/TD                                                         AVECT     36
          BF1=F1+FN1*TT                                                     AVECT     37
          BF2=F2+FN2*TT                                                     AVECT     38
          BF3=F3+FN3*TT                                                     AVECT     39
          AL=SQRT(BF1**2+BF2**2+BF3**2)                                     AVECT     40
          BF1=BF1/AL                                                        AVECT     41
          BF2=BF2/AL                                                        AVECT     42
          BF3=BF3/AL                                                        AVECT     43
          F1=AA(1,1)*BF1+AA(1,2)*BF2+AA(1,3)*BF3                            AVECT     44
          F2=AA(2,1)*BF1+AA(2,2)*BF2+AA(2,3)*BF3                            AVECT     45
          F3=EN1*BF1+EN2*BF2+EN3*BF3                                        AVECT     46
          BG1=EN2*BF3-EN3*BF2                                               AVECT     47
          BG2=EN3*BF1-EN1*BF3                                               AVECT     48
          BG3=EN1*BF2-EN2*BF1                                               AVECT     49
          AL=SQRT(BG1**2+BG2**2+BG3**2)                                     AVECT     50
          BG1=BG1/AL                                                        AVECT     51
          BG2=BG2/AL                                                        AVECT     52
          BG3=BG3/AL                                                        AVECT     53
          G1=AA(1,1)*BG1+AA(1,2)*BG2+AA(1,3)*BG3                            AVECT     54
          G2=AA(2,1)*BG1+AA(2,2)*BG2+AA(2,3)*BG3                            AVECT     55
          G3=EN1*BG1+EN2*BG2+EN3*BG3                                        AVECT     56
          ASIGN=EN1*FN1+EN2*FN2+EN3*FN3                                     AVECT     57
          ASIGN=ASIGN/ABS(ASIGN)                                            AVECT     58
```

```
    2     CONTINUE                                     AVECT      59
          G1=G1*ASIGN                                  AVECT      60
          G2=G2*ASIGN                                  AVECT      61
          DO 3 N=1,NZ                                  AVECT      62
          THETA(N,1)=F1*THE(N,1)+G1*THE(N,2)           AVECT      63
          THETA(N,2)=F2*THE(N,1)+G2*THE(N,2)           AVECT      64
    3     THETA(N,3)=0.0                               AVECT      65
          RETURN                                       AVECT      66
          END                                          AVECT      67
```

```
          SUBROUTINE SURFACE (SX,BASEAE,SSTT,SSTC,LOADS,STHK,LLOD)         SURF     2
C     SJX,--(LOADS) NEEDS TO BE GREATER THAN OR EQUAL TO LOADS IN          SURF     3
C     MAIN PROGRAM                                                         SURF     4
          DIMENSION SX(1), SJX(10), STHK(1)                                SURF     5
          AMAX=0.0                                                         SURF     6
          LLOD=0                                                           SURF     7
          DO 1 I=1,LOADS                                                   SURF     8
          STRESS=SSTT                                                      SURF     9
          IF (SX(I).LT.0.) STRESS=SSTC                                     SURF    10
    1     SJX(I)=ABS(SX(I))/STRESS                                         SURF    11
          STRSS=BASEAE                                                     SURF    12
          DO 2 I=1,LOADS                                                   SURF    13
          IF (AMAX.GT.SJX(I)) GO TO 2                                      SURF    14
          AMAX=SJX(I)                                                      SURF    15
          LLOD=I                                                           SURF    16
    2     CONTINUE                                                         SURF    17
          STHK(1)=AMAX                                                     SURF    18
          IF (STRSS.GE.AMAX) RETURN                                        SURF    19
          RATIO=AMAX/STRSS                                                 SURF    20
          BASEAE=BASEAE*RATIO                                              SURF    21
          RETURN                                                           SURF    22
          END                                                              SURF    23
```

```
      SUBROUTINE COORD (MA,MB,MC,MD,X,Y,Z,AA,XI,ETA,AL,NND,NO,AB)          COORD     2
      DIMENSION X(1), Y(1), Z(1), AA(3,3), AB(3), XI(5), ETA(5)            COORD     3
      K1=MA                                                                COORD     4
      K2=MB                                                                COORD     5
      K3=MC                                                                COORD     6
      K4=MD                                                                COORD     7
      XCOMP=X(K2)-X(K1)                                                    COORD     8
      YCOMP=Y(K2)-Y(K1)                                                    COORD     9
      ZCOMP=Z(K2)-Z(K1)                                                    COORD    10
      AL=SQRT(XCOMP**2+YCOMP**2+ZCOMP**2)                                  COORD    11
      AA(1,1)=XCOMP/AL                                                     COORD    12
      AA(1,2)=YCOMP/AL                                                     COORD    13
      AA(1,3)=ZCOMP/AL                                                     COORD    14
      IF (NND.LT.3) RETURN                                                 COORD    15
      XCOMP=X(K3)-X(K1)                                                    COORD    16
      YCOMP=Y(K3)-Y(K1)                                                    COORD    17
      ZCOMP=Z(K3)-Z(K1)                                                    COORD    18
      AL=SQRT(XCOMP**2+YCOMP**2+ZCOMP**2)                                  COORD    19
      AB(1)=XCOMP/AL                                                       COORD    20
      AB(2)=YCOMP/AL                                                       COORD    21
      AB(3)=ZCOMP/AL                                                       COORD    22
      AL=SQRT((AA(1,2)*AB(3)-AA(1,3)*AB(2))**2+(AA(1,3)*AB(1)-AA(1,1)*AB   COORD    23
     1(3))**2+(AA(1,1)*AB(2)-AA(1,2)*AB(1))**2)                            COORD    24
      AA(2,1)=((AA(1,3)**2)*AB(1)-AA(1,1)*AA(1,3)*AB(3)-AA(1,1)*AA(1,2)*   COORD    25
     1AB(2)+(AA(1,2)**2)*AB(1))/AL                                         COORD    26
      AA(2,2)=((AA(1,1)**2)*AB(2)-AA(1,1)*AA(1,2)*AB(1)-AA(1,2)*AA(1,3)*   COORD    27
     1AB(3)+(AA(1,3)**2)*AB(2))/AL                                         COORD    28
      AA(2,3)=((AA(1,2)**2)*AB(3)-AA(1,2)*AA(1,3)*AB(2)-AA(1,1)*AA(1,3)*   COORD    29
     1AB(1)+(AA(1,1)**2)*AB(3))/AL                                         COORD    30
      IF (NO.EQ.1) RETURN                                                  COORD    31
      XI(1)=0.0                                                            COORD    32
      ETA(1)=0.0                                                           COORD    33
      XI(2)=(X(K2)-X(K1))*AA(1,1)+(Y(K2)-Y(K1))*AA(1,2)+(Z(K2)-Z(K1))*AA   COORD    34
     1(1,3)                                                                COORD    35
      ETA(2)=0.0                                                           COORD    36
      XI(3)=(X(K3)-X(K1))*AA(1,1)+(Y(K3)-Y(K1))*AA(1,2)+(Z(K3)-Z(K1))*AA   COORD    37
     1(1,3)                                                                COORD    38
      ETA(3)=(X(K3)-X(K1))*AA(2,1)+(Y(K3)-Y(K1))*AA(2,2)+(Z(K3)-Z(K1))*A   COORD    39
     1A(2,3)                                                               COORD    40
      IF (NND.LE.3) GO TO 1                                                COORD    41
      XI(4)=(X(K4)-X(K1))*AA(1,1)+(Y(K4)-Y(K1))*AA(1,2)+(Z(K4)-Z(K1))*AA   COORD    42
     1(1,3)                                                                COORD    43
      ETA(4)=(X(K4)-X(K1))*AA(2,1)+(Y(K4)-Y(K1))*AA(2,2)+(Z(K4)-Z(K1))*A   COORD    44
     1A(2,3)                                                               COORD    45
      XI(5)=(XI(2)+XI(3)+XI(4))/4.0                                        COORD    46
      ETA(5)=(ETA(3)+ETA(4))/4.0                                           COORD    47
    1 CONTINUE                                                             COORD    48
      RETURN                                                               COORD    49
      END                                                                  COORD    50
```

```
      SUBROUTINE ELAS (AA,AB,EE,EO,DA,E)                                    ELAS   2
      DIMENSION AA(3,3), AB(1), EE(3,3), EO(3), DA(3,3), EA(3,3), E(3,3)    ELAS   3
      DIMENSION EP(3,3)                                                     ELAS   4
      EOK=SQRT(EO(1)**2+EO(2)**2+EO(3)**2)                                  ELAS   5
      DO 1 I=1,3                                                            ELAS   6
    1 EO(I)=EO(I)/EOK                                                       ELAS   7
      EN1=AA(1,2)*AA(2,3)-AA(2,2)*AA(1,3)                                   ELAS   8
      EN2=AA(1,3)*AA(2,1)-AA(1,1)*AA(2,3)                                   ELAS   9
      EN3=AA(1,1)*AA(2,2)-AA(1,2)*AA(2,1)                                   ELAS  10
      AL=SQRT(EN1**2+EN2**2+EN3**2)                                         ELAS  11
      EN1=EN1/AL                                                            ELAS  12
      EN2=EN2/AL                                                            ELAS  13
      EN3=EN3/AL                                                            ELAS  14
      A1=AA(1,1)*EO(1)+AA(1,2)*EO(2)+AA(1,3)*EO(3)                          ELAS  15
      A2=AA(2,1)*EO(1)+AA(2,2)*EO(2)+AA(2,3)*EO(3)                          ELAS  16
      A3=EN1*EO(1)+EN2*EO(2)+EN3*EO(3)                                      ELAS  17
      B1=EN2*A3-EN3*A2                                                      ELAS  18
      B2=EN3*A1-EN1*A3                                                      ELAS  19
      B3=EN1*A2-EN2*A1                                                      ELAS  20
      AL=SQRT(B1**2+B2**2+B3**2)                                            ELAS  21
      B1=B1/AL                                                              ELAS  22
      B2=B2/AL                                                              ELAS  23
      B3=B3/AL                                                              ELAS  24
      AL11=A1                                                               ELAS  25
      AL12=A2                                                               ELAS  26
      AL21=B1                                                               ELAS  27
      AL22=B2                                                               ELAS  28
      DA(1,1)=AL11**2                                                       ELAS  29
      DA(2,1)=AL12**2                                                       ELAS  30
      DA(3,1)=AL11*AL12                                                     ELAS  31
      DA(1,2)=AL21**2                                                       ELAS  32
      DA(2,2)=AL22**2                                                       ELAS  33
      DA(3,2)=AL21*AL22                                                     ELAS  34
      DA(1,3)=2.*AL11*AL21                                                  ELAS  35
      DA(2,3)=2.*AL22*AL12                                                  ELAS  36
      DA(3,3)=AL12*AL21+AL11*AL22                                           ELAS  37
      DO 2 I=1,3                                                            ELAS  38
      DO 2 J=1,3                                                            ELAS  39
    2 EA(I,J)=0.0                                                           ELAS  40
      DO 3 I=1,3                                                            ELAS  41
      DO 3 K=1,3                                                            ELAS  42
      DO 3 J=1,3                                                            ELAS  43
    3 EA(I,K)=EA(I,K)+DA(I,J)*EE(J,K)                                       ELAS  44
      DO 4 I=1,3                                                            ELAS  45
      DO 4 J=1,3                                                            ELAS  46
    4 EP(I,J)=DA(J,I)                                                       ELAS  47
      DO 5 I=1,3                                                            ELAS  48
      DO 5 J=1,3                                                            ELAS  49
    5 DA(I,J)=0.0                                                           ELAS  50
      DO 6 I=1,3                                                            ELAS  51
      DO 6 J=1,3                                                            ELAS  52
    6 E(I,J)=0.0                                                            ELAS  53
      DO 7 I=1,3                                                            ELAS  54
      DO 7 K=1,3                                                            ELAS  55
      DO 7 J=1,3                                                            ELAS  56
    7 E(I,K)=E(I,K)+EA(I,J)*EP(J,K)                                         ELAS  57
      DO 8 I=1,3                                                            ELAS  58
```

```
          DO 8 J=1,3                                        ELAS     59
        8 DA(I,J)=EP(I,J)                                   ELAS     60
          DA(1,3)=DA(1,3)*2.                                ELAS     61
          DA(2,3)=DA(2,3)*2.                                ELAS     62
          DA(3,1)=DA(3,1)/2.                                ELAS     63
          DA(3,2)=DA(3,2)/2.                                ELAS     64
          RETURN                                            ELAS     65
          END                                               ELAS     66
```

AD-A040 257 AIR FORCE FLIGHT DYNAMICS LAB WRIGHT-PATTERSON AFB OHIO F/G 9/2
COMPUTER PROGRAM (OPTCOMP) FOR OPTIMIZATION OF COMPOSITE STRUCT--ETC(U)
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```
            SUBROUTINE STRAIN (UV,X,Y,EX,EY,EXY,L,TRI)                    STRAIN     2
            DIMENSION UV(12,L), X(3), Y(3), EX(1), EY(1), EXY(1), A(3,3)  STRAIN     3
            DET=X(1)*(Y(2)-Y(3))+X(2)*(Y(3)-Y(1))+X(3)*(Y(1)-Y(2))       STRAIN     4
            TRI=DET/2.0                                                   STRAIN     5
            A(1,1)=Y(2)-Y(3)                                              STRAIN     6
            A(2,1)=X(3)-X(2)                                              STRAIN     7
            A(3,1)=X(2)*Y(3)-X(3)*Y(2)                                    STRAIN     8
            A(1,2)=Y(3)-Y(1)                                              STRAIN     9
            A(2,2)=X(1)-X(3)                                              STRAIN    10
            A(3,2)=X(3)*Y(1)-X(1)*Y(3)                                    STRAIN    11
            A(1,3)=Y(1)-Y(2)                                              STRAIN    12
            A(2,3)=X(2)-X(1)                                              STRAIN    13
            A(3,3)=X(1)*Y(2)-X(2)*Y(1)                                    STRAIN    14
            DO 1 I=1,3                                                    STRAIN    15
            DO 1 J=1,3                                                    STRAIN    16
      1     A(I,J)=A(I,J)/DET                                             STRAIN    17
            DO 3 K=1,L                                                    STRAIN    18
            EX(K)=0.0                                                     STRAIN    19
            EY(K)=0.0                                                     STRAIN    20
            EXY(K)=0.0                                                    STRAIN    21
            KX=0.0                                                        STRAIN    22
            DO 2 I=1,3                                                    STRAIN    23
            IX=I+KX                                                       STRAIN    24
            EX(K)=EX(K)+A(1,I)*UV(IX,K)                                   STRAIN    25
            EY(K)=EY(K)+A(2,I)*UV(IX+1,K)                                 STRAIN    26
            EXY(K)=EXY(K)+A(2,I)*UV(IX,K)+A(1,I)*UV(IX+1,K)               STRAIN    27
      2     KX=KX+1                                                       STRAIN    28
      3     CONTINUE                                                      STRAIN    29
            RETURN                                                        STRAIN    30
            END                                                           STRAIN    31
```

```
      SUBROUTINE COMP (EK,THK,TRIANG,XI,ETA,E)                                COMP      2
      DIMENSION EK(12,12), XI(5), ETA(5), E(3,3)                              COMP      3
      X32=XI(3)-XI(2)                                                         COMP      4
      X31=XI(3)-0.0                                                           COMP      5
      X21=XI(2)-0.0                                                           COMP      6
      Y32=ETA(3)-0.0                                                          COMP      7
      Y31=ETA(3)-0.0                                                          COMP      8
      Y21=0.0                                                                 COMP      9
      TRIANG=ABS(XI(2))*ABS(ETA(3))/2.                                        COMP     10
      DO 1 I=1,12                                                             COMP     11
      DO 1 J=1,12                                                             COMP     12
    1 EK(I,J)=0.0                                                             COMP     13
      E11=E(1,1)                                                              COMP     14
      E12=E(1,2)                                                              COMP     15
      E13=E(1,3)                                                              COMP     16
      E23=E(2,3)                                                              COMP     17
      E22=E(2,2)                                                              COMP     18
      E33=E(3,3)                                                              COMP     19
      EK(1,1)=E11*Y32**2-2.*E13*X32*Y32+E33*X32**2                            COMP     20
      EK(2,1)=-E12*X32*Y32+E23*X32**2+E13*Y32**2-E33*X32*Y32+EK(2,1)          COMP     21
      EK(3,1)=-E11*Y31*Y32+E13*X32*Y31+E13*X31*Y32-E33*X31*X32+EK(3,1)        COMP     22
      EK(4,1)=E12*Y32*X31-E23*X32*X31-E13*Y31*Y32+E33*X32*Y31+EK(4,1)         COMP     23
      EK(5,1)=E11*Y21*Y32-E13*X32*Y21-E13*X21*Y32+E33*X32*X21+EK(5,1)         COMP     24
      EK(6,1)=-E12*X21*Y32+E23*X32*X21+E13*Y32*Y21-E33*X32*Y21+EK(6,1)        COMP     25
      EK(2,2)=E22*X32**2-2.*E23*X32*Y32+E33*Y32**2+EK(2,2)                    COMP     26
      EK(3,2)=-E13*Y31*Y32+E12*X32*Y31+E33*X31*Y32-E23*X32*X31+EK(3,2)        COMP     27
      EK(4,2)=E23*X31*Y32-E22*X32*X31-E33*Y32*Y31+E23*X32*Y31+EK(4,2)         COMP     28
      EK(5,2)=E13*Y32*Y21-E12*X32*Y21-E33*Y32*X21+E23*X32*X21+EK(5,2)         COMP     29
      EK(6,2)=-E23*Y32*X21+E22*X32*X21+E33*Y32*Y21-E23*X32*Y21+EK(6,2)        COMP     30
      EK(3,3)=-E13*X31*Y31+E11*Y31**2+E33*X31**2-E13*X31*Y31+EK(3,3)          COMP     31
      EK(4,3)=E23*X31**2-E12*Y31*X31-E33*X31*Y31+E13*Y31**2+EK(4,3)           COMP     32
      EK(5,3)=E13*X31*Y21-E11*Y31*Y21-E33*X31*X21+E13*Y31*X21+EK(5,3)         COMP     33
      EK(6,3)=-E23*X31*X21+E12*Y31*X21+E33*X31*Y21-E13*Y21*Y31+EK(6,3)        COMP     34
      EK(4,4)=E22*X31**2-2.*E23*X31*Y31+E33*Y31**2+EK(4,4)                    COMP     35
      EK(5,4)=E12*X31*Y21-E13*Y31*Y21-E23*X31*X21+E33*Y31*X21+EK(5,4)         COMP     36
      EK(6,4)=-E22*X21*X31+E23*Y31*X21+E23*X31*Y21-E33*Y31*Y21+EK(6,4)        COMP     37
      EK(5,5)=E11*Y21**2-2.*E13*X21*Y21+E33*X21**2+EK(5,5)                    COMP     38
      EK(6,5)=-E12*Y21*X21+E23*X21**2+E13*Y21**2-E33*X21*Y21+EK(6,5)          COMP     39
      EK(6,6)=-E23*Y21*X21*2.+E22*X21**2+E33*Y21**2                           COMP     40
      DO 2 I=1,6                                                              COMP     41
      IP=I+1                                                                  COMP     42
      DO 2 J=IP,6                                                             COMP     43
    2 EK(I,J)=EK(J,I)                                                         COMP     44
      DO 3 I=1,6                                                              COMP     45
      DO 3 J=1,6                                                              COMP     46
    3 EK(I,J)=(EK(I,J)/TRIANG)*THK*0.25                                       COMP     47
      RETURN                                                                  COMP     48
      END                                                                     COMP     49
```

```
      SUBROUTINE ELSTIF (A,B,C,AE,MM,AL,EBAR,EC)                    ESTIF     2
      DIMENSION A(3,3), B(12,12), C(12,12)                          ESTIF     3
      CF=EBAR/EC                                                    ESTIF     4
      EK=AE*CF/AL                                                   ESTIF     5
      DO 1 I=1,MM                                                   ESTIF     6
      J=I+MM                                                        ESTIF     7
      B(1,I)=EK*A(1,I)                                              ESTIF     8
      B(1,J)=-B(1,I)                                                ESTIF     9
      B(2,I)=-B(1,I)                                                ESTIF    10
    1 B(2,J)=B(1,I)                                                 ESTIF    11
      DO 2 I=1,MM                                                   ESTIF    12
      DO 2 J=1,MM                                                   ESTIF    13
    2 C(I,J)=A(1,I)*B(1,J)                                          ESTIF    14
      DO 3 I=1,MM                                                   ESTIF    15
      I1=I+MM                                                       ESTIF    16
      DO 3 J=1,MM                                                   ESTIF    17
      J1=J+MM                                                       ESTIF    18
      C(I,J1)=-C(I,J)                                               ESTIF    19
      C(J1,I)=-C(I,J)                                               ESTIF    20
    3 C(I1,J1)=C(I,J)                                               ESTIF    21
      RETURN                                                        ESTIF    22
      END                                                           ESTIF    23
```

```
              SUBROUTINE ASEMBL (A,B,MA,MB,MC,MD,MM,ID,NNODES,M)      ASEMBL    2
              DIMENSION A(1), B(M,M), ID(1), NA(4), NAA(3)            ASEMBL    3
              IX(I,J)=I*(J-1)+1                                       ASEMBL    4
              M2=NNODES*MM                                            ASEMBL    5
              NA(1)=IX(MM,MA)                                         ASEMBL    6
              NA(2)=IX(MM,MB)                                         ASEMBL    7
              IF (NNODES.GE.3) NA(3)=IX(MM,MC)                        ASEMBL    8
              IF (NNODES.GE.4) NA(4)=IX(MM,MD)                        ASEMBL    9
              IF (NNODES.LE.3) GO TO 2                                ASEMBL   10
              DO 1 I=1,3                                              ASEMBL   11
              KX=I/3                                                  ASEMBL   12
              KY=I/2                                                  ASEMBL   13
              IF (NA(KX+2).LT.NA(KY+3)) GO TO 1                       ASEMBL   14
              KH=NA(KX+2)                                             ASEMBL   15
              NA(KX+2)=NA(KY+3)                                       ASEMBL   16
              NA(KY+3)=KH                                             ASEMBL   17
        1     CONTINUE                                                ASEMBL   18
        2     DO 3 I=2,NNODES                                         ASEMBL   19
        3     NAA(I-1)=NA(I)-NA(I-1)-MM                               ASEMBL   20
              KH=MM                                                   ASEMBL   21
              IAA=NA(1)                                               ASEMBL   22
              KHH=1                                                   ASEMBL   23
              DO 7 J=1,M2                                             ASEMBL   24
              IF (J.LE.KH) GO TO 4                                    ASEMBL   25
              KHH=KHH+1                                               ASEMBL   26
              IAA=NA(KHH)                                             ASEMBL   27
              KH=KH+MM                                                ASEMBL   28
        4     JX=ID(IAA)-IAA+NA(1)                                    ASEMBL   29
              KY=MM                                                   ASEMBL   30
              DO 6 I=1,J                                              ASEMBL   31
              IF (J.LE.KY.OR.I.LE.KY) GO TO 5                         ASEMBL   32
              KX=I/MM                                                 ASEMBL   33
              JX=JX+NAA(KX)                                           ASEMBL   34
              KY=KY+MM                                                ASEMBL   35
        5     A(JX)=A(JX)+B(I,J)                                      ASEMBL   36
        6     JX=JX+1                                                 ASEMBL   37
        7     IAA=IAA+1                                               ASEMBL   38
              RETURN                                                  ASEMBL   39
              END                                                     ASEMBL   40
```

```
      SUBROUTINE CONDNS (EK,EKK,MA,MB,MC,MD,NO)                     CONDNS   2
      DIMENSION EK(12,12), EKK(12,12)                               CONDNS   3
      IF (NO.EQ.2) GO TO 6                                          CONDNS   4
      DO 1 I=1,12                                                   CONDNS   5
      DO 1 J=1,12                                                   CONDNS   6
    1 EKK(I,J)=0.                                                   CONDNS   7
      DET=EK(9,9)*EK(10,10)-EK(9,10)**2                             CONDNS   8
      AX=EK(9,9)                                                    CONDNS   9
      EK(9,9)=EK(10,10)/DET                                         CONDNS  10
      EK(10,10)=AX/DET                                              CONDNS  11
      EK(9,10)=-EK(9,10)/DET                                        CONDNS  12
      EK(10,9)=EK(9,10)                                             CONDNS  13
      KX=0                                                          CONDNS  14
      DO 2 I=9,10                                                   CONDNS  15
      KX=KX+1                                                       CONDNS  16
      DO 2 J=1,8                                                    CONDNS  17
      DO 2 K=9,10                                                   CONDNS  18
    2 EKK(KX,J)=EKK(KX,J)+EK(I,K)*EK(K,J)                           CONDNS  19
      IF (NO.EQ.1) RETURN                                           CONDNS  20
      KX=0                                                          CONDNS  21
      DO 3 I=9,10                                                   CONDNS  22
      KX=KX+1                                                       CONDNS  23
      DO 3 J=1,8                                                    CONDNS  24
      EK(I,J)=EKK(KX,J)                                             CONDNS  25
    3 EKK(KX,J)=0                                                   CONDNS  26
      DO 4 I=1,8                                                    CONDNS  27
      DO 4 J=1,8                                                    CONDNS  28
      DO 4 K=9,10                                                   CONDNS  29
    4 EKK(I,J)=EKK(I,J)+EK(I,K)*EK(K,J)                             CONDNS  30
      DO 5 I=1,8                                                    CONDNS  31
      DO 5 J=1,8                                                    CONDNS  32
    5 EK(I,J)=EK(I,J)-EKK(I,J)                                      CONDNS  33
      IF (NO.EQ.3) RETURN                                           CONDNS  34
    6 CONTINUE                                                      CONDNS  35
      NZE=0                                                         CONDNS  36
      NTH=3                                                         CONDNS  37
      NFO=4                                                         CONDNS  38
      NFI=5                                                         CONDNS  39
      NSE=7                                                         CONDNS  40
      NTW=12                                                        CONDNS  41
      IF (MC.LT.MB) CALL CHANGE (EK,NTH,NFI,NFO,NTW,NTW,NZE)        CONDNS  42
      IF (MD.LT.MB) CALL CHANGE (EK,NTH,NSE,NFO,NTW,NTW,NZE)        CONDNS  43
      IF (MD.LT.MC) CALL CHANGE (EK,NFI,NSE,NFO,NTW,NTW,NZE)        CONDNS  44
      RETURN                                                        CONDNS  45
      END                                                           CONDNS  46
```

```
              SUBROUTINE SUM (EK,EKK,MA,MB,MC)                          SUM      2
              DIMENSION EK(12,12), EKK(12,12), NA(3)                    SUM      3
              M=2                                                       SUM      4
              NA(1)=2*(MA-1)+1                                          SUM      5
              NA(2)=2*(MB-1)+1                                          SUM      6
              NA(3)=2*(MC-1)+1                                          SUM      7
              IH=0                                                      SUM      8
              DO 4 I=1,6                                                SUM      9
              JH=0                                                      SUM     10
              IF (I.LE.IH) GO TO 1                                      SUM     11
              IH=IH+M                                                   SUM     12
              IHH=IH/M                                                  SUM     13
              KX=NA(IHH)                                                SUM     14
        1     DO 3 J=1,6                                                SUM     15
              IF (J.LE.JH) GO TO 2                                      SUM     16
              JH=JH+M                                                   SUM     17
              IHH=JH/M                                                  SUM     18
              KY=NA(IHH)                                                SUM     19
        2     EK(KX,KY)=EK(KX,KY)+EKK(I,J)                              SUM     20
        3     KY=KY+1                                                   SUM     21
        4     KX=KX+1                                                   SUM     22
              RETURN                                                    SUM     23
              END                                                       SUM     24
```

```
      SUBROUTINE CHANGE (EK,IX,IY,NND,M,L,IR)                 CHANG      2
      DIMENSION EK(M,L)                                       CHANG      3
      KX=IX                                                   CHANG      4
      KY=IY                                                   CHANG      5
      M2=2*NND                                                CHANG      6
      IF (IR.EQ.1) M2=L                                       CHANG      7
      DO 2 I=1,2                                              CHANG      8
      DO 1 J=1,M2                                             CHANG      9
      AX=EK(KX,J)                                             CHANG     10
      EK(KX,J)=EK(KY,J)                                       CHANG     11
    1 EK(KY,J)=AX                                             CHANG     12
      KX=KX+1                                                 CHANG     13
    2 KY=KY+1                                                 CHANG     14
      IF (IR.EQ.1) RETURN                                     CHANG     15
      KX=KX-2                                                 CHANG     16
      KY=KY-2                                                 CHANG     17
      DO 4 I=1,2                                              CHANG     18
      DO 3 J=1,M2                                             CHANG     19
      AX=EK(J,KX)                                             CHANG     20
      EK(J,KX)=EK(J,KY)                                       CHANG     21
    3 EK(J,KY)=AX                                             CHANG     22
      KX=KX+1                                                 CHANG     23
    4 KY=KY+1                                                 CHANG     24
      RETURN                                                  CHANG     25
      END                                                     CHANG     26
```

```
      SUBROUTINE TRNSFM (EK,AA,B,C,MM,NNO,M)                              TRNSF   2
      DIMENSION EK(12,12), AA(3,3), B(M,M), C(M,M)                        TRNSF   3
      M2=2*NNO                                                            TRNSF   4
      M3=MM*NNO                                                           TRNSF   5
      DO 3 I=1,M2                                                         TRNSF   6
      JA=MM                                                               TRNSF   7
      KA=0                                                                TRNSF   8
      IA=0                                                                TRNSF   9
      DO 3 J=1,M3                                                         TRNSF  10
      B(I,J)=0.0                                                          TRNSF  11
      IF (J-JA) 2,2,1                                                     TRNSF  12
    1 JA=JA+MM                                                            TRNSF  13
      KA=KA+2                                                             TRNSF  14
      IA=IA+MM                                                            TRNSF  15
    2 JAA=J-IA                                                            TRNSF  16
      DO 3 K=1,2                                                          TRNSF  17
      KAA=K+KA                                                            TRNSF  18
    3 B(I,J)=B(I,J)+EK(I,KAA)*AA(K,JAA)                                   TRNSF  19
      DO 6 J=1,M3                                                         TRNSF  20
      JA=MM                                                               TRNSF  21
      KA=0                                                                TRNSF  22
      IA=0                                                                TRNSF  23
      DO 6 I=1,M3                                                         TRNSF  24
      C(I,J)=0.0                                                          TRNSF  25
      IF (I-JA) 5,5,4                                                     TRNSF  26
    4 JA=JA+M1                                                            TRNSF  27
      KA=KA+2                                                             TRNSF  28
      IA=IA+M1                                                            TRNSF  29
    5 JAA=I-IA                                                            TRNSF  30
      DO 6 K=1,2                                                          TRNSF  31
      KAA=K+KA                                                            TRNSF  32
    6 C(I,J)=C(I,J)+AA(K,JAA)*B(KAA,J)                                    TRNSF  33
      RETURN                                                              TRNSF  34
      END                                                                 TRNSF  35
```

```
                SUBROUTINE POP (MMB,JN,MM,MA,MB,MC,MD,KTYPE,IC,ID,NZ)            POP    2
                DIMENSION MA(1), MB(1), MC(1), MD(1), IC(1), ID(1), KTYPE(1)     POP    3
                IX(I,J)=I*(J-1)+1                                                POP    4
                NZ=0                                                             POP    5
                NN=MM*JN                                                         POP    6
                DO 1 I=1,NN                                                      POP    7
      1         IC(I)=NN                                                         POP    8
                DO 9 L=1,MMB                                                     POP    9
                KNODE=4                                                          POP   10
                IF (KTYPE(L).LE.4) KNODE=KTYPE(L)                                POP   11
                NNODES=2                                                         POP   12
                ITRI=0                                                           POP   13
                KX=IX(MM,MA(L))                                                  POP   14
                KY=IX(MM,MB(L))                                                  POP   15
      2         IF (IC(KY).LT.KX) GO TO 4                                        POP   16
                DO 3 I=1,MM                                                      POP   17
                IC(KY)=KX                                                        POP   18
      3         KY=KY+1                                                          POP   19
      4         IF (KNODE-3) 8,5,6                                               POP   20
      5         IF (ITRI.EQ.1) GO TO 8                                           POP   21
                KY=IX(MM,MC(L))                                                  POP   22
                ITRI=1                                                           POP   23
                NNODES=3                                                         POP   24
                GO TO 2                                                          POP   25
      6         IF (ITRI.EQ.2) GO TO 8                                           POP   26
                IF (ITRI.EQ.1) GO TO 7                                           POP   27
                KY=IX(MM,MC(L))                                                  POP   28
                ITRI=ITRI+1                                                      POP   29
                NNODES=4                                                         POP   30
                GO TO 2                                                          POP   31
      7         KY=IX(MM,MD(L))                                                  POP   32
                ITRI=ITRI+1                                                      POP   33
                GO TO 2                                                          POP   34
      8         CONTINUE                                                         POP   35
      9         CONTINUE                                                         POP   36
                DO 11 I=1,NN,MM                                                  POP   37
                IF (IC(I).LT.I) GO TO 11                                         POP   38
                KX=I                                                             POP   39
                DO 10 J=1,MM                                                     POP   40
                IC(KX)=I                                                         POP   41
     10         KX=KX+1                                                          POP   42
     11         CONTINUE                                                         POP   43
                DO 12 I=1,NN                                                     POP   44
                NZ=NZ+(I-IC(I)+1)                                                POP   45
     12         ID(I)=NZ                                                         POP   46
                KX=(NN*(NN+1))/2                                                 POP   47
                WRITE (6,13)                                                     POP   48
                WRITE (6,14) KX,NZ                                               POP   49
                WRITE (6,15)                                                     POP   50
                WRITE (6,16) (IC(I),I=1,NN)                                      POP   51
                WRITE (6,17)                                                     POP   52
                WRITE (6,16) (ID(I),I=1,NN)                                      POP   53
                RETURN                                                           POP   54
      C                                                                          POP   55
     13         FORMAT (1H1,////20X,16HGROSS POPULATION,24X,19HAPPARENT POPULATION POP   56
               1)                                                                POP   57
     14         FORMAT (//18X,I14,18X,I22//)                                     POP   58
```

```
      15   FORMAT (//2X,36HSTARTING ROW NUMBERS FOR EACH COLUMN///)           POP    59
      16   FORMAT (5X,10I12)                                                  POP    60
      17   FORMAT (//2X,61HNUMBERS OF DIAGONAL ELEMENTS IN SINGLE ARRAYSTIFFN POP    61
          1ESS MATRIX ///)                                                    POP    62
           END                                                                POP    63
```

SUBROUTINE GAUSS 74/74 OPT=1 FTN 4.5+414 10/29/76 12.20.33 PAGE 1

```
      SUBROUTINE GAUSS (A,F,D,IC,ID,L,N,NN,NOCOMP)
      DIMENSION A(1), IC(1), ID(1), F(NN,L), D(NN,L)
      IF (NOCOMP.EQ.1) GO TO 5
      DO 4 I=1,N
      I1=I-1
      DO 3 J=I,N
      IF (IC(J).GT.I) GO TO 3
      IX=ID(J)-J+I
      IF (I1.EQ.0) GO TO 2
      DO 1 K=1,I1
      IF (IC(J).GT.K.OR.IC(I).GT.K) GO TO 1
      KX=ID(I)-I+K
      KY=ID(J)-J+K
      KZ=ID(K)
      A(IX)=A(IX)-(A(KX)*A(KZ)*A(KY))
    1 CONTINUE
    2 IF (I.EQ.J) GO TO 3
      KZ=ID(I)
      IF (A(KZ).EQ.0.) GO TO 12
      A(IX)=A(IX)/A(KZ)
    3 CONTINUE
    4 CONTINUE
    5 DO 8 K=1,L
      DO 7 I=1,N
      D(I,K)=F(I,K)
      I1=I-1
      IF (I1.EQ.0) GO TO 7
      DO 6 J=1,I1
      IF (IC(I).GT.J) GO TO 6
      IX=ID(I)-I+J
      D(I,K)=D(I,K)-A(IX)*D(J,K)
    6 CONTINUE
    7 CONTINUE
    8 CONTINUE
      DO 9 I=1,N
      KX=ID(I)
      DO 9 K=1,L
    9 D(I,K)=D(I,K)/A(KX)
      DO 11 K=1,L
      IX=N
      DO 11 I=2,N
      IX=IX-1
      I1=I-1
      KX=IX
      DO 10 J=1,I1
      KX=KX+1
      IF (IC(KX).GT.IX) GO TO 10
      KY=ID(KX)-KX+IX
      D(IX,K)=D(IX,K)-A(KY)*D(KX,K)
   10 CONTINUE
   11 CONTINUE
      GO TO 13
   12 WRITE (6,14)
   13 RETURN
C
   14 FORMAT (///2X,21HSTRUCTURE IS UNSTABLE///)
      END
```

```
      SUBROUTINE BOUND (A,IB,N,NB,ID,IC)
      DIMENSION A(1), IB(1), ID(1), IC(1)
      IH=NB
      NH=N
      DO 7 JA=1,NB
      IA=IB(IA)
      IF (IA.GE.NH) GO TO 6
      KH=IA+1
      IF (IA.GT.1) GO TO 1
      KX=1
      JX=1
      GO TO 2
    1 JX=ID(IA)-ID(IA-1)
      KX=ID(IA-1)+1
    2 DO 5 I=KH,NH
      KY=1
      IF (IC(I).LE.IA) GO TO 3
      IC(I-1)=IC(I)-1
      I1=I
      KY=0
      GO TO 4
    3 IC(I-1)=IC(I)
      I1=I-1
    4 K=ID(I)
      ID(I-1)=ID(I)-JX-KY
      DO 5 J=K,I1
      IF (J.EQ.IA) JX=JX+1
      KXX=KX+JX
      A(KX)=A(KXX)
    5 KX=KX+1
    6 NH=NH-1
      IH=IH-1
    7 CONTINUE
      RETURN
      END
```

```
            SUBROUTINE PRNTDR (A,B,X,Y,Z,IB,N,M,L,NJ,NP,NB,NBB,NN)            PRNTD     2
            DIMENSION A(NN,L), B(NN,L), X(1), Y(1), Z(1), IB(1)               PRNTD     3
            IF (NBB.EQ.0) WRITE (6,12)                                        PRNTD     4
            IF (NBB.NE.0) WRITE (6,13)                                        PRNTD     5
            NP=NP+1                                                           PRNTD     6
            K1=1                                                              PRNTD     7
            JJN=70/L+1                                                        PRNTD     8
            WRITE (6,15)                                                      PRNTD     9
            DO 11 I=1,NJ                                                      PRNTD    10
            IF (NBB.NE.0) GO TO 1                                             PRNTD    11
            IF (I.NE.JJN) GO TO 1                                             PRNTD    12
            JJN=70/L+JJN                                                      PRNTD    13
            WRITE (6,14)                                                      PRNTD    14
            WRITE (6,15)                                                      PRNTD    15
            NP=NP+1                                                           PRNTD    16
    1       KH=M*I                                                            PRNTD    17
            KHH=KH-M+1                                                        PRNTD    18
            IF (NBB.EQ.0) GO TO 5                                             PRNTD    19
            ICHK=0                                                            PRNTD    20
            DO 3 IJ=K1,NB                                                     PRNTD    21
            IF (IB(IJ).GE.KHH.AND.IB(IJ).LE.KH) GO TO 2                       PRNTD    22
            IF (IB(IJ).GT.KH) GO TO 4                                         PRNTD    23
            GO TO 3                                                           PRNTD    24
    2       K1=K1+1                                                           PRNTD    25
            ICHK=1                                                            PRNTD    26
    3       CONTINUE                                                          PRNTD    27
    4       CONTINUE                                                          PRNTD    28
            IF (ICHK.EQ.0) GO TO 11                                           PRNTD    29
    5       CONTINUE                                                          PRNTD    30
            IF (M.LT.3) GO TO 6                                               PRNTD    31
            WRITE (6,16) I,X(I),Y(I),Z(I),(A(J,1),J=KHH,KH),(B(J,1),J=KHH,KH) PRNTD    32
            GO TO 7                                                           PRNTD    33
    6       WRITE (6,17) I,X(I),Y(I),(A(J,1),J=KHH,KH),(B(J,1),J=KHH,KH)      PRNTD    34
    7       IF (L.EQ.1) GO TO 10                                              PRNTD    35
            DO 9 K=2,L                                                        PRNTD    36
            IF (M.LT.3) GO TO 8                                               PRNTD    37
            WRITE (6,18) (A(J,K),J=KHH,KH),(B(J,K),J=KHH,KH)                  PRNTD    38
            GO TO 9                                                           PRNTD    39
    8       WRITE (6,19) (A(J,K),J=KHH,KH),(B(J,K),J=KHH,KH)                  PRNTD    40
    9       CONTINUE                                                          PRNTD    41
    10      CONTINUE                                                          PRNTD    42
    11      CONTINUE                                                          PRNTD    43
            RETURN                                                            PRNTD    44
    C                                                                         PRNTD    45
    12      FORMAT (1H1,48X,23H*****DISPLACEMENTS*****,1X/)                   PRNTD    46
    13      FORMAT (1H1,48X,19H*****REACTIONS*****,1X,/)                      PRNTD    47
    14      FORMAT (1H1,////)                                                 PRNTD    48
    15      FORMAT (//1X,5HJOINT,8X,2H-X,8X,2H-Y,8X,2H-Z,8X,7HFORCE-X,7X,7HFOR PRNTD    49
           1CE-Y,7X,7HFORCE-Z,8X,7HDISPL-X,10X,7HDISPL-Y,10X,7HDISPL-Z//)     PRNTD    50
    16      FORMAT (I5,F14.3,F10.3,F10.3,F12.3,F14.3,F14.3,1PE18.8,1PE17.8,1PE PRNTD    51
           117.8)                                                             PRNTD    52
    17      FORMAT (I5,F14.3,F10.3,10X,F12.3,F14.3,14X,1PE18.8,1PE17.8)       PRNTD    53
    18      FORMAT (39X,F12.3,F14.3,F14.3,1PE18.8,1PE17.8,1PE17.8)            PRNTD    54
    19      FORMAT (39X,F12.3,F14.3,14X,1PE18.8,1PE17.8)                      PRNTD    55
            END                                                               PRNTD    56
```

```
    SUBROUTINE PRNTDR      74/74    OPT=1                              FTN 4.5+414        10/29/76  12.20.38        PAGE      2
CARD NR. SEVERITY  DETAILS    DIAGNOSIS OF PROBLEM
      24     I       K1        THIS STATEMENT REDEFINES A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
```

```
      SUBROUTINE REDUCE (F,IB,N,NB,L,NN)                        REDUCE   2
      DIMENSION F(NN,L), IB(1)                                  REDUCE   3
      DO 5 J=1,L                                                REDUCE   4
      IH=NB                                                     REDUCE   5
      NH=N                                                      REDUCE   6
    1 I=IB(IH)                                                  REDUCE   7
      IF (I-NH) 2,4,4                                           REDUCE   8
    2 NH1=NH-1                                                  REDUCE   9
      DO 3 K=I,NH1                                              REDUCE  10
      K1=K+1                                                    REDUCE  11
    3 F(K,J)=F(K1,J)                                            REDUCE  12
    4 IH=IH-1                                                   REDUCE  13
      NH=NH-1                                                   REDUCE  14
      IF (IH.EQ.0) GO TO 5                                      REDUCE  15
      GO TO 1                                                   REDUCE  16
    5 CONTINUE                                                  REDUCE  17
      RETURN                                                    REDUCE  18
      END                                                       REDUCE  19
```

```
SUBROUTINE RESTOR       74/74    OPT=1                          FTN 4.5+414          10/29/76  12.20.38          PAGE     1

                SUBROUTINE RESTOR (D,IB,N,NB,L,NN)                              RESTOR     2
                DIMENSION D(NN,L), IB(1), TDR1(10), TDR2(10)                    RESTOR     3
                NH=N-NB                                                         RESTOR     4
                IH=1                                                            RESTOR     5
        1       I=IB(IH)                                                        RESTOR     6
                IF (I.GT.NH) GO TO 7                                            RESTOR     7
                DO 2 K=1,L                                                      RESTOR     8
                TDR1(K)=D(I,K)                                                  RESTOR     9
        2       D(I,K)=0.                                                       RESTOR    10
        3       J=I+1                                                           RESTOR    11
                IF (J.GT.NH) GO TO 5                                            RESTOR    12
                DO 4 K=1,L                                                      RESTOR    13
        4       TDR2(K)=D(J,K)                                                  RESTOR    14
        5       DO 6 K=1,L                                                      RESTOR    15
                D(J,K)=TDR1(K)                                                  RESTOR    16
        6       TDR1(K)=TDR2(K)                                                 RESTOR    17
                IF (I.GE.NH) GO TO 9                                            RESTOR    18
                I=I+1                                                           RESTOR    19
                GO TO 3                                                         RESTOR    20
        7       DO 8 K=1,L                                                      RESTOR    21
        8       D(I,K)=0.                                                       RESTOR    22
        9       IF (IH.GE.NB) GO TO 10                                          RESTOR    23
                IH=IH+1                                                         RESTOR    24
                NH=NH+1                                                         RESTOR    25
                GO TO 1                                                         RESTOR    26
        10      CONTINUE                                                        RESTOR    27
                RETURN                                                          RESTOR    28
                END                                                             RESTOR    29
```

```
      SUBROUTINE ELSTRS (EDR,A,AL,SX,E,L,ENG)                           ELSTRS   2
      DIMENSION EDR(12,L), A(3,3), SX(1), ENG(1)                        ELSTRS   3
      DO 1 K=1,L                                                        ELSTRS   4
      SX(K)=(EDR(1,K)-EDR(2,K))/AL                                      ELSTRS   5
      SX(K)=-SX(K)                                                      ELSTRS   6
      ENG(K)=SX(K)*SX(K)*E                                              ELSTRS   7
      SX(K)=E*SX(K)                                                     ELSTRS   8
    1 CONTINUE                                                          ELSTRS   9
      RETURN                                                            ELSTRS  10
      END                                                               ELSTRS  11
```

```
      SUBROUTINE SCOMP (EK,THK,QTR,X,Y,G,EC)                            SCOMP    2
      DIMENSION EK(12,12), X(5), Y(5)                                   SCOMP    3
      QTR=(X(2)*Y(3)+X(3)*Y(4)-X(3)*Y(2)-X(4)*Y(3))*0.5                 SCOMP    4
      XI=X(4)-X(2)                                                      SCOMP    5
      EK(1,1)=XI**2/4.                                                  SCOMP    6
      EK(2,1)=-Y(4)*XI/4.                                               SCOMP    7
      EK(3,1)=-X(3)*XI/4.                                               SCOMP    8
      EK(4,1)=XI*Y(3)/4.                                                SCOMP    9
      EK(2,2)=Y(4)**2/4.                                                SCOMP   10
      EK(3,2)=Y(4)*X(3)/4.                                              SCOMP   11
      EK(4,2)=-Y(4)*Y(3)/4.                                             SCOMP   12
      EK(3,3)=X(3)**2/4.                                                SCOMP   13
      EK(4,3)=-X(3)*Y(3)/4.0                                            SCOMP   14
      EK(4,4)=Y(3)**2/4.                                                SCOMP   15
      DO 1 I=1,3                                                        SCOMP   16
      K=I+1                                                             SCOMP   17
      DO 1 J=K,4                                                        SCOMP   18
    1 EK(I,J)=EK(J,I)                                                   SCOMP   19
      DO 2 I=1,4                                                        SCOMP   20
      L=I+4                                                             SCOMP   21
      DO 2 J=1,4                                                        SCOMP   22
    2 EK(L,J)=-EK(I,J)                                                  SCOMP   23
      DO 3 I=1,8                                                        SCOMP   24
      DO 3 J=1,4                                                        SCOMP   25
      K=J+4                                                             SCOMP   26
    3 EK(I,K)=-EK(I,J)                                                  SCOMP   27
      DO 4 I=1,8                                                        SCOMP   28
      DO 4 J=1,8                                                        SCOMP   29
      EK(I,J)=EK(I,J)*G*THK/QTR                                         SCOMP   30
      EK(I,J)=EK(I,J)/EC                                                SCOMP   31
    4 CONTINUE                                                          SCOMP   32
      RETURN                                                            SCOMP   33
      END                                                               SCOMP   34
```

SUBROUTINE SSRS 74/74 OPT=1 FTN 4.5+414 10/29/76 12.20.38 PAGE 1

```
      SUBROUTINE SSRS (UV,X,Y,THK,AREA,TA,G,L,ENG)
      DIMENSION UV(12,L), X(5), Y(5), TA(1), A(8), ENG(1)
      AREA=(X(2)*Y(3)+X(3)*Y(4)-X(3)*Y(2)-X(4)*Y(3))*0.5
      A(1)=X(4)-X(2)
      A(2)=-Y(4)
      A(3)=-X(3)
      A(4)=Y(3)
      DO 1 I=1,4
      J=I+4
    1 A(J)=-A(I)
      DO 2 I=1,8
    2 A(I)=A(I)*THK/2.
      DO 3 K=1,L
      TA(K)=0.0
      DO 3 I=1,8
    3 TA(K)=TA(K)+A(I)*UV(I,K)*G/(AREA*THK)
      DO 4 I=1,L
      ENG(I)=TA(I)**2/G
    4 CONTINUE
      RETURN
      END
```

```
                   SUBROUTINE BFORCE (PRCT,AX,AY,AXY,ASX,ASY,ASXY,NZ,LOADS)      BFORCE     2
              C  DIMENSIONS OF AX,AY,AXY,ASX,ASY,ASXY, CONSISTENT WITH THOSE IN   BFORCE     3
              C  MEMB SUBROUTINE                                                  BFORCE     4
                   DIMENSION PRCT(1), AX(1,10), AY(1,10), AXY(1,10), ASX(4,10,4), ASY BFORCE  5
                  1(4,10,4), ASXY(4,10,4)                                         BFORCE     6
                   I=1                                                            BFORCE     7
                   DO 1 J=1,LOADS                                                 BFORCE     8
                   AX(I,J)=1.0                                                    BFORCE     9
                   AY(I,J)=0.0                                                    BFORCE    10
                   AXY(I,J)=0.0                                                   BFORCE    11
                   DO 1 K=1,NZ                                                    BFORCE    12
                   AX(I,J)=PRCT(K)*ASX(I,J,K)+AX(I,J)                             BFORCE    13
                   AY(I,J)=PRCT(K)*ASY(I,J,K)+AY(I,J)                             BFORCE    14
                   AXY(I,J)=PRCT(K)*ASXY(I,J,K)+AXY(I,J)                          BFORCE    15
                1  CONTINUE                                                       BFORCE    16
                   RETURN                                                         BFORCE    17
                   END                                                            BFORCE    18
```

SUBROUTINE SBUCKL   74/74   OPT=1   FTN 4.5+414   10/29/76 12.20.38   PAGE   1

```
      SUBROUTINE SBUCKL (A,AX,AY,AXY,THK,LOADS,AWIDE,BWIDE,TMAX)         SBUCK      2
      DIMENSION A(3,3), AX(1,10), AY(1,10), AXY(1,10)                     SBUCK      3
C  ALL DIMENSIONS CONSISTENT WITH THOSE IN MEMB SUBROUTINE                SBUCK      4
      I=1                                                                 SBUCK      5
      DO 1 J=1,LOADS                                                      SBUCK      6
      AX(I,J)=AX(I,J)*(-1.*THK)                                           SBUCK      7
      AY(I,J)=AY(I,J)*(-1.*THK)                                           SBUCK      8
1     AXY(I,J)=AXY(I,J)*(-1.*THK)                                         SBUCK      9
      TMAX=THK                                                            SBUCK     10
      APY=3.1415927**2                                                    SBUCK     11
      I=1                                                                 SBUCK     12
      DO 7 J=1,LOADS                                                      SBUCK     13
      AB=0.0                                                              SBUCK     14
      AC=0.0                                                              SBUCK     15
      ANXY=AXY(I,J)                                                       SBUCK     16
      BETA=A(2,2)/A(1,1)                                                  SBUCK     17
      ALPHA=2.*(A(1,2)+2.*A(3,3))/A(1,1)                                  SBUCK     18
      ANX=0.0                                                             SBUCK     19
      IF (AX(I,J).LT.0..AND.AY(I,J).LT.0.) GO TO 5                        SBUCK     20
      IY=0                                                                SBUCK     21
      GAMA=0.                                                             SBUCK     22
      IF (AY(I,J).LT.0.) GO TO 2                                          SBUCK     23
      IF (AX(I,J).LT.0.) GO TO 3                                          SBUCK     24
      GAMA=AY(I,J)/AX(I,J)                                                SBUCK     25
      IF (GAMA.GT.1.) IY=1                                                SBUCK     26
2     CONTINUE                                                            SBUCK     27
      ANX=AX(I,J)                                                         SBUCK     28
      IF (IY.EQ.0) GO TO 4                                                SBUCK     29
3     CONTINUE                                                            SBUCK     30
      BETA=1./BETA                                                        SBUCK     31
      ALPHA=ALPHA*A(1,1)/A(2,2)                                           SBUCK     32
      IF (GAMA.NE.0.) GAMA=1./GAMA                                        SBUCK     33
      ANX=AY(I,J)                                                         SBUCK     34
      IY=1                                                                SBUCK     35
4     CONTINUE                                                            SBUCK     36
      AAMU=GAMA**2-ALPHA*GAMA+BETA                                        SBUCK     37
      IF (AAMU.LT.0.) ANX=0.0                                             SBUCK     38
      IF (AAMU.LT.0.) GO TO 5                                             SBUCK     39
      AMU=-GAMA+AAMU**0.5                                                 SBUCK     40
      AKX=(AMU**2+ALPHA*AMU+BETA)/(AMU+GAMA)                              SBUCK     41
      ANXCR=AKX*APY*A(1,1)/(12.*AWIDE**2)                                 SBUCK     42
      IF (IY.EQ.1) ANXCR=AKX*APY*A(2,2)/(12.*BWIDE**2)                    SBUCK     43
      GO TO 6                                                             SBUCK     44
5     CONTINUE                                                            SBUCK     45
6     CONTINUE                                                            SBUCK     46
      THETA=2.*BETA**0.5/ALPHA                                            SBUCK     47
      AKXY=(4.742+0.216*THETA+0.38*THETA**2)*(ALPHA*BETA/2.)**0.5         SBUCK     48
      IF (THETA.GE.1.) AKXY=(3.293+2.047/THETA)*BETA**0.75                SBUCK     49
      ANXYCR=AKXY*APY*A(1,1)/(AWIDE**2.*12.)                              SBUCK     50
      IF (IY.EQ.1) ANXYCR=AKXY*APY*A(2,2)/(BWIDE**2.*12.)                 SBUCK     51
      IF (ANX.NE.0.) AB=ANX/ANXCR                                         SBUCK     52
      AC=(ANXY/ANXYCR)**2                                                 SBUCK     53
      AA=AB**2+4.*AC                                                      SBUCK     54
      AA=SQRT(AA)                                                         SBUCK     55
      THK1=(AB+AA)/2.                                                     SBUCK     56
      THK2=(AB-AA)/2.                                                     SBUCK     57
      IF (THK1.LT.THK2) THK1=THK2                                         SBUCK     58
```

```
                   TH3=THK1**0.33333                                                 SBUCK     59
                   IF (TMAX.LT.TH3) TMAX=TH3                                         SBUCK     60
 60          7     CONTINUE                                                          SBUCK     61
                   RETURN                                                            SBUCK     62
             C                                                                       SBUCK     63
                   END                                                               SBUCK     64
```

```
      SUBROUTINE ANORM (A,AL,MEMBS,AMAX,NC,NZ,NCC)              ANORM   2
      DIMENSION A(1), AL(NCC,NZ)                                ANORM   3
      AMAX=0.0                                                  ANORM   4
      DO 7 K=1,2                                                ANORM   5
      IF (NC.EQ.0) GO TO 3                                      ANORM   6
      DO 2 I=1,NC                                               ANORM   7
      A(I)=0.0                                                  ANORM   8
      DO 1 J=1,NZ                                               ANORM   9
      A(I)=A(I)+AL(I,J)                                         ANORM  10
    1 CONTINUE                                                  ANORM  11
    2 CONTINUE                                                  ANORM  12
    3 CONTINUE                                                  ANORM  13
      IF (K.EQ.2) RETURN                                        ANORM  14
      DO 4 I=1,MEMBS                                            ANORM  15
    4 IF (AMAX.LT.A(I)) AMAX=A(I)                               ANORM  16
      K1=NC+1                                                   ANORM  17
      DO 5 I=K1,MEMBS                                           ANORM  18
    5 A(I)=A(I)/AMAX                                            ANORM  19
      IF (NC.EQ.0) GO TO 7                                      ANORM  20
      DO 6 I=1,NC                                               ANORM  21
      DO 6 J=1,NZ                                               ANORM  22
      AL(I,J)=AL(I,J)/AMAX                                      ANORM  23
    6 CONTINUE                                                  ANORM  24
    7 CONTINUE                                                  ANORM  25
      RETURN                                                    ANORM  26
      END                                                       ANORM  27
```

```
      SUBROUTINE MULT (SK,FR,DR,IC,ID,N,LD,NC)                          MULT     2
      DIMENSION IC(1), ID(1), SK(1), DR(NC,LD), FR(NC,LD)               MULT     3
      DO 7 I=1,N                                                        MULT     4
      DO 1 K=1,LD                                                       MULT     5
    1 FR(I,K)=0.0                                                       MULT     6
      K1=IC(I)                                                          MULT     7
      DO 7 J=K1,N                                                       MULT     8
      I1=I-1                                                            MULT     9
      J1=J-1                                                            MULT    10
      IF (J-I) 2,3,4                                                    MULT    11
    2 IF (IC(I).GT.J) GO TO 7                                           MULT    12
      KM=ID(I1)+J-IC(I)+1                                               MULT    13
      GO TO 5                                                           MULT    14
    3 KM=ID(J)                                                          MULT    15
      GO TO 5                                                           MULT    16
    4 IF (IC(J).GT.I) GO TO 7                                           MULT    17
      KM=ID(J1)+I-IC(J)+1                                               MULT    18
    5 CONTINUE                                                          MULT    19
      DO 6 L=1,LD                                                       MULT    20
      FR(I,L)=FR(I,L)+SK(KM)*DR(J,L)                                    MULT    21
    6 CONTINUE                                                          MULT    22
    7 CONTINUE                                                          MULT    23
      RETURN                                                            MULT    24
      END                                                               MULT    25
```

```
      SUBROUTINE ENGS (SSMAX,BSX,BSY,BSXY,PX,PY,PXY,EXFI,EYFI,EXYFI,ENG, ENGS   2
     1EFFSTR,LOADS,NZ,KM,NCRTIA,NENG,NEF)                                ENGS   3
      COMMON /CC/ E11,E22,ANU1,ANU2,GSH                                  ENGS   4
C  ALL DIMENSIONS TO BE CONSISTENT WITH THOSE IN MEMB SUBROUTINE         ENGS   5
      DIMENSION BSX(4,10,4), BSY(4,10,4), BSXY(4,10,4), SSMAX(5,4,4), E1 ENGS   6
     11(4,4), E22(4,4), ANU1(4,4), ANU2(4,4), GSH(4,4), EXFI(4,10,4), EY ENGS   7
     2FI(4,10,4), EXYFI(4,10,4), ENG(10,4), TRI(1), EFFSTR(4,10,4), PX(4 ENGS   8
     3,10,4), PY(4,10,4), PXY(4,10,4)                                    ENGS   9
      DO 3 J=1,LOADS                                                     ENGS  10
      DO 3 K=1,NZ                                                        ENGS  11
      ENG(J,K)=0.0                                                       ENGS  12
      I=1                                                                ENGS  13
      X1=SSMAX(1,K,KM)                                                   ENGS  14
      IF (BSX(I,J,K).LT.0.) X1=SSMAX(2,K,KM)                             ENGS  15
      X2=SSMAX(3,K,KM)                                                   ENGS  16
      IF (BSY(I,J,K).LT.0.) X2=SSMAX(4,K,KM)                             ENGS  17
      X3=SSMAX(5,K,KM)                                                   ENGS  18
      PX(I,J,K)=ABS(BSX(I,J,K)/X1)                                       ENGS  19
      PY(I,J,K)=ABS(BSY(I,J,K)/X2)                                       ENGS  20
      PXY(I,J,K)=ABS(BSXY(I,J,K)/X3)                                     ENGS  21
      EF1=PX(I,J,K)**2+PY(I,J,K)**2+PXY(I,J,K)**2                        ENGS  22
      EF2=PX(I,J,K)*PY(I,J,K)                                            ENGS  23
      IF (NEF.EQ.1) EFFSTR(I,J,K)=EF1-EF2                                ENGS  24
      IF (NEF.EQ.2) EFFSTR(I,J,K)=EF1-EF2*X2/X1                          ENGS  25
      EFH=EF1-EF2                                                        ENGS  26
      EFN=EF1-EF2*X2/X1                                                  ENGS  27
      IF (NCRTIA.EQ.2) GO TO 1                                           ENGS  28
      Y1=(X1-ANU1(K,KM)*X2)/E11(K,KM)                                    ENGS  29
      Y2=(X2-ANU2(K,KM)*X1)/E22(K,KM)                                    ENGS  30
      Y3=X3/GSH(K,KM)                                                    ENGS  31
      GO TO 2                                                            ENGS  32
    1 CONTINUE                                                           ENGS  33
      CNU=1.-ANU1(K,KM)*ANU2(K,KM)                                       ENGS  34
      C11=E11(K,KM)/CNU                                                  ENGS  35
      C22=E22(K,KM)/CNU                                                  ENGS  36
      C12=E22(K,KM)*ANU1(K,KM)/CNU                                       ENGS  37
      Y1=X1*C11+X2*C12                                                   ENGS  38
      Y2=X1*C12+X2*C22                                                   ENGS  39
      Y3=X3*GSH(K,KM)                                                    ENGS  40
    2 CONTINUE                                                           ENGS  41
      EC1=X1*Y1                                                          ENGS  42
      EC2=X2*Y2                                                          ENGS  43
      EC3=X3*Y3                                                          ENGS  44
      EC2=EC1                                                            ENGS  45
      EC3=EC1                                                            ENGS  46
      E1=BSX(I,J,K)*EXFI(I,J,K)                                          ENGS  47
      E2=BSY(I,J,K)*EYFI(I,J,K)                                          ENGS  48
      E3=BSXY(I,J,K)*EXYFI(I,J,K)                                        ENGS  49
      IF (NENG.EQ.1) ENG(J,K)=ENG(J,K)+(E1+E2+E3)                        ENGS  50
      IF (NENG.EQ.2) ENG(J,K)=ENG(J,K)+E1/EC1+E2/EC2+E3/EC3              ENGS  51
      IF(NENG.EQ.3) ENG(J,K)=ENG(J,K)+EFH                                ENGS  52
      IF(NENG.EQ.4) ENG(J,K)=ENG(J,K)+EFN                                ENGS  53
      EFFSTR(I,J,K)=EFFSTR(I,J,K)**0.5                                   ENGS  54
    3 CONTINUE                                                           ENGS  55
      RETURN                                                             ENGS  56
      END                                                                ENGS  57
```

```
      SUBROUTINE STRES (E,E1,EX,EY,EXY,SXLO,SYLO,SXYLO,SXZO,SYZO,SXYZO,E STRESS   2
     1XFI,EYFI,EXYFI,SXFI,SYFI,SXYFI,DA,AD,LOS,I,IL)                     STRESS   3
C  ALL DIMENSIONS TO BE CONSISTENT WITH THOSE IN MEMB SUBROUTINE         STRESS   4
      DIMENSION E(3,3), EX(10), EY(10), EXY(10), SXLO(4,10,4), SYLO(4,10 STRESS   5
     1,4), SXYLO(4,10,4), SXZO(4,10,4), SYZO(4,10,4), SXYZO(4,10,4), SXF STRESS   6
     2I(4,10,4), SYFI(4,10,4), SXYFI(4,10,4), DA(3,3), AD(3,3), EXFI(4,1 STRESS   7
     30,4), EYFI(4,10,4), EXYFI(4,10,4)                                  STRESS   8
C     COMMENT I=TRIANGLE    IL=  LOADING CONDITION  K=  LAYER            STRESS   9
      DO 1 K=1,LOS                                                       STRESS  10
C                                                                        STRESS  11
      SXLO(I,K,IL)=(E(1,1)*EX(K)+E(1,2)*EY(K)+E(1,3)*EXY(K))*E1          STRESS  12
      SYLO(I,K,IL)=(E(2,1)*EX(K)+E(2,2)*EY(K)+E(2,3)*EXY(K))*E1          STRESS  13
      SXYLO(I,K,IL)=(E(3,1)*EX(K)+E(3,2)*EY(K)+E(3,3)*EXY(K))*E1         STRESS  14
      SXFI(I,K,IL)=DA(1,1)*SXLO(I,K,IL)+DA(1,2)*SYLO(I,K,IL)+DA(1,3)*SXY STRESS  15
     1LO(I,K,IL)                                                         STRESS  16
      SYFI(I,K,IL)=DA(2,1)*SXLO(I,K,IL)+DA(2,2)*SYLO(I,K,IL)+DA(2,3)*SXY STRESS  17
     1LO(I,K,IL)                                                         STRESS  18
      SXYFI(I,K,IL)=DA(3,1)*SXLO(I,K,IL)+DA(3,2)*SYLO(I,K,IL)+DA(3,3)*SX STRESS  19
     1YLO(I,K,IL)                                                        STRESS  20
      SXZO(I,K,IL)=AD(1,1)*SXLO(I,K,IL)+AD(1,2)*SYLO(I,K,IL)+AD(1,3)*SXY STRESS  21
     1LO(I,K,IL)                                                         STRESS  22
      SYZO(I,K,IL)=AD(2,1)*SXLO(I,K,IL)+AD(2,2)*SYLO(I,K,IL)+AD(2,3)*SXY STRESS  23
     1LO(I,K,IL)                                                         STRESS  24
      SXYZO(I,K,IL)=AD(3,1)*SXLO(I,K,IL)+AD(3,2)*SYLO(I,K,IL)+AD(3,3)*SX STRESS  25
     1YLO(I,K,IL)                                                        STRESS  26
      EXFI(I,K,IL)=DA(1,1)*EX(K)+DA(1,2)*EY(K)+DA(1,3)*EXY(K)/2.0        STRESS  27
      EYFI(I,K,IL)=DA(2,1)*EX(K)+DA(2,2)*EY(K)+DA(2,3)*EXY(K)/2.0        STRESS  28
      EXYFI(I,K,IL)=DA(3,1)*EX(K)*2.+DA(3,2)*EY(K)*2.+DA(3,3)*EXY(K)     STRESS  29
    1 CONTINUE                                                           STRESS  30
      RETURN                                                             STRESS  31
      END                                                                STRESS  32
```

```
      SUBROUTINE SHILL (EFFSTR,LOADS,BASEAE,LLOD,LCRI,LLYR,NZ,STHK)        SHILL    2
C  EFFSTR DIMENSION CONSISTENT WITH THAT IN MEMB SUBROUTINE               SHILL    3
      DIMENSION STHK(1)                                                  SHILL    4
      DIMENSION EFFSTR(4,10,4)                                           SHILL    5
      LCRI=1                                                             SHILL    6
      AMAX=0.0                                                           SHILL    7
      STRSS=BASEAE                                                       SHILL    8
      I=1                                                                SHILL    9
      DO 2 J=1,LOADS                                                     SHILL   10
      DO 2 K=1,NZ                                                        SHILL   11
      IF (AMAX.GT.EFFSTR(I,J,K)) GO TO 1                                 SHILL   12
      AMAX=EFFSTR(I,J,K)                                                 SHILL   13
      LLOD=J                                                             SHILL   14
      LLYR=K                                                             SHILL   15
    1 CONTINUE                                                           SHILL   16
    2 CONTINUE                                                           SHILL   17
      IF (STRSS.GE.AMAX) GO TO 3                                         SHILL   18
      RATIO=AMAX/STRSS                                                   SHILL   19
      BASEAE=BASEAE*RATIO                                                SHILL   20
    3 CONTINUE                                                           SHILL   21
      DO 6 K=1,NZ                                                        SHILL   22
      I=1                                                                SHILL   23
      DO 5 J=1,LOADS                                                     SHILL   24
      IF (EFFSTR(I,J,K).LT.AMAX) GO TO 4                                 SHILL   25
      AMAX=EFFSTR(I,J,K)                                                 SHILL   26
    4 CONTINUE                                                           SHILL   27
    5 CONTINUE                                                           SHILL   28
      STHK(K)=AMAX                                                       SHILL   29
    6 CONTINUE                                                           SHILL   30
      RETURN                                                             SHILL   31
      END                                                                SHILL   32
```

```
            SUBROUTINE AVSTRS (ABC,TRANG,QUAD,LDS,NZ)                AVG     2
            DIMENSION ABC(4,10,4), TRANG(4)                          AVG     3
            DO 2 J=1,LDS                                             AVG     4
            DO 2 K=1,NZ                                              AVG     5
            AMAX=0.0                                                 AVG     6
            DO 1 I=1,4                                               AVG     7
            AMAX=AMAX+ABC(I,J,K)*TRANG(I)                            AVG     8
    1       CONTINUE                                                 AVG     9
            AMAX=AMAX/QUAD                                           AVG    10
            ABC(1,J,K)=AMAX                                          AVG    11
    2       CONTINUE                                                 AVG    12
            RETURN                                                   AVG    13
            END                                                      AVG    14
```

```
      SUBROUTINE AEQ (X,Y,Z,FR,IBND,NN,LD,JOINTS,NB,MM)
C  DIMENSIONS OF AML,AMR,AFL,AFR,AL,AR, NEEDS CHANGE ONLY IF LOADS IN
C  MAIN IS GREATER THAN 10
      DIMENSION X(1), Y(1), Z(1), FR(NN,LD), IBND(1)
      DIMENSION AML(3,10), AMR(3,10), AFL(3,10), AFR(3,10), AL(3,10), AR
     1(3,10)
      WRITE (6,13)
      DO 1 I=1,LD
      DO 1 J=1,MM
      AML(J,I)=0.0
      AMR(J,I)=0.0
      AFL(J,I)=0.0
      AFR(J,I)=0.0
    1 CONTINUE
      K1=1
      IP=0
      DO 10 I=1,JOINTS
      DO 2 I1=1,MM
      DO 2 J1=1,LD
      AL(I1,J1)=0.0
    2 AR(I1,J1)=0.0
      DO 8 J=1,MM
      IP=IP+1
      DO 6 K=K1,NB
      IF (IBND(K).EQ.IP) GO TO 4
      DO 3 L=1,LD
    3 AL(J,L)=FR(IP,L)
      GO TO 6
    4 DO 5 L=1,LD
    5 AR(J,L)=FR(IP,L)
      K1=K1+1
      GO TO 7
    6 CONTINUE
    7 CONTINUE
    8 CONTINUE
      DO 9 J=1,LD
      AMR(1,J)=AMR(1,J)+Y(I)*AR(3,J)-Z(I)*AR(2,J)
      AML(1,J)=AML(1,J)+Y(I)*AL(3,J)-Z(I)*AL(2,J)
      AMR(2,J)=AMR(2,J)+Z(I)*AR(1,J)-X(I)*AR(3,J)
      AML(2,J)=AML(2,J)+Z(I)*AL(1,J)-X(I)*AL(3,J)
      AMR(3,J)=AMR(3,J)+X(I)*AR(2,J)-Y(I)*AR(1,J)
      AML(3,J)=AML(3,J)+X(I)*AL(2,J)-Y(I)*AL(1,J)
      AFL(1,J)=AFL(1,J)+AL(1,J)
      AFR(1,J)=AFR(1,J)+AR(1,J)
      AFL(2,J)=AFL(2,J)+AL(2,J)
      AFR(2,J)=AFR(2,J)+AR(2,J)
      AFL(3,J)=AFL(3,J)+AL(3,J)
      AFR(3,J)=AFR(3,J)+AR(3,J)
    9 CONTINUE
   10 CONTINUE
      WRITE (6,14)
      WRITE (6,15)
      DO 11 J=1,LD
   11 WRITE (6,16) J,(AML(I,J),I=1,3),(AFL(I,J),I=1,3)
      WRITE (6,17)
      WRITE (6,15)
      DO 12 J=1,LD
```

```
      12     WRITE (6,16) J,(AMR(I,J),I=1,3),(AFR(I,J),I=1,3)
             RETURN                                                          AEQ      59
      C                                                                      AEQ      60
      13     FORMAT (1H1,54X,19HSUMMATION OF FORCES,1X/)                     AEQ      61
      14     FORMAT (10X,13HAPPLIED LOADS,1X,/)                              AEQ      62
      15     FORMAT (3X,9HLOAD COND,5X,2HMX,13X,2HMY,13X,2HMZ,13X,2HFX,13X,2HFY AEQ   63
           1,13X,2HFZ/)                                                      AEQ      64
      16     FORMAT (/,4X,I5,6E15.6)                                         AEQ      65
      17     FORMAT (/,10X,9HREACTIONS,1X,/)                                 AEQ      66
             END                                                             AEQ      67
                                                                             AEQ      68
```

CARD NR.	SEVERITY	DETAILS	DIAGNOSIS OF PROBLEM
31	I	K1	THIS STATEMENT REDEFINES A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.

```
      SUBROUTINE ALINK (A,AL,STRENG,STNG,ELENTH,NELEM,NLINK,NZ,NC,NSKIN, ALINK    2
     1NINT,NSTBLTY,NCC)                                                  ALINK    3
C  DIMENSION OF NELEM CONSISTENT WITH THAT IN MAIN PROGRAM               ALINK    4
C  ASUM,SAREA,--(NZ)                                                     ALINK    5
      DIMENSION A(1), AL(NCC,NZ), STRENG(NCC,NZ), STNG(1), ELENTH(1), NL ALINK    6
     1INK(1)                                                             ALINK    7
      DIMENSION NELEM(5,10), ASUM(4), SAREA(4)                           ALINK    8
      IF (NSKIN.EQ.0) GO TO 9                                            ALINK    9
      DO 8 I=1,NSKIN                                                     ALINK   10
      IK=NLINK(I)                                                        ALINK   11
      DO 1 IL=1,NZ                                                       ALINK   12
      ASUM(IL)=0.0                                                       ALINK   13
    1 SAREA(IL)=0.0                                                      ALINK   14
      DO 3 J=1,IK                                                        ALINK   15
      MEM=NELEM(I,J)                                                     ALINK   16
      DO 2 IL=1,NZ                                                       ALINK   17
      IF (NSTBLTY.GT.0) STRENG(MEM,IL)=1.0                               ALINK   18
      ASUM(IL)=ASUM(IL)+ELENTH(MEM)*STRENG(MEM,IL)*AL(MEM,IL)            ALINK   19
      IF (NSTBLTY.GT.0) AL(MEM,IL)=1.0                                   ALINK   20
      SAREA(IL)=SAREA(IL)+ELENTH(MEM)*AL(MEM,IL)                         ALINK   21
    2 CONTINUE                                                           ALINK   22
    3 CONTINUE                                                           ALINK   23
      DO 4 IL=1,NZ                                                       ALINK   24
    4 ASUM(IL)=ASUM(IL)/SAREA(IL)                                        ALINK   25
      DO 7 J=1,IK                                                        ALINK   26
      MEM=NELEM(I,J)                                                     ALINK   27
      DO 6 IL=1,NZ                                                       ALINK   28
      IF (NSTBLTY.GT.0) GO TO 5                                          ALINK   29
      STRENG(MEM,IL)=ASUM(IL)                                            ALINK   30
      GO TO 6                                                            ALINK   31
    5 AL(MEM,IL)=ASUM(IL)                                                ALINK   32
    6 CONTINUE                                                           ALINK   33
    7 CONTINUE                                                           ALINK   34
    8 CONTINUE                                                           ALINK   35
    9 CONTINUE                                                           ALINK   36
      IF (NINT.EQ.0) GO TO 14                                            ALINK   37
      NP=NSKIN+1                                                         ALINK   38
      DO 13 I=NP,NINT                                                    ALINK   39
      IK=NLINK(I)                                                        ALINK   40
      ASUM(1)=0.0                                                        ALINK   41
      SAREA(1)=0.0                                                       ALINK   42
      DO 10 J=1,IK                                                       ALINK   43
      MEM=NELEM(I,J)                                                     ALINK   44
      IP=MEM-NC                                                          ALINK   45
      IF (NSTBLTY.GT.0) STNG(IP)=1.0                                     ALINK   46
      ASUM(1)=ASUM(1)+ELENTH(MEM)*STNG(IP)*A(MEM)                        ALINK   47
      IF (NSTBLTY.GT.0) A(MEM)=1.0                                       ALINK   48
      SAREA(1)=SAREA(1)+ELENTH(MEM)*A(MEM)                               ALINK   49
   10 CONTINUE                                                           ALINK   50
      ASUM(1)=ASUM(1)/SAREA(1)                                           ALINK   51
      DO 12 J=1,IK                                                       ALINK   52
      MEM=NELEM(I,J)                                                     ALINK   53
      IP=MEM-NC                                                          ALINK   54
      IF (NSTBLTY.GT.0) GO TO 11                                         ALINK   55
      STNG(IP)=ASUM(1)                                                   ALINK   56
      GO TO 12                                                           ALINK   57
   11 A(IP)=ASUM(1)                                                      ALINK   58
```

```
             12     CONTINUE                                          ALINK      59
             13     CONTINUE                                          ALINK      60
 60          14     CONTINUE                                          ALINK      61
                    RETURN                                            ALINK      62
                    END                                               ALINK      63
```

```
FWA OF THE LOAD            101
LWA+1 OF THE LOAD        75060

TRANSFER ADDRESS -- OPTCOMP          6662


ENTRY POINTS.

ENTRY        ADDRESS        PROGRAM

INPUT#         2551         OPTCOMP
TAPE5#         2551
OUTPUT#        4612
TAPE6#         4612
OPTCOMP        6662
MEMB          36231         MEMB
SUGD          50604         SUGD
AVECT         50773         AVECT
SURFACE       51241         SURFACE
COORD         51325         COORD
ELAS          51601         ELAS
STRAIN        52166         STRAIN
COMP          52357         COMP
ELSTIF        53026         ELSTIF
ASEMBL        53202         ASEMBL
CONDNS        53416         CONDNS
SUM           53725         SUM
CHANGE        54044         CHANGE
TRNSFM        54173         TRNSFM
POP           54365         POP
GAUSS         54710         GAUSS
BOUND         55233         BOUND
PRNTDR        55373         PRNTDR
REDUCE        56020         REDUCE
RESTOR        56121         RESTOR
ELSTRS        56260         ELSTRS
SCOMP         56306         SCOMP
SSRS          56511         SSRS
BFORCE        56663         BFORCE
SBUCKL        56763         SBUCKL
ANORM         57271         ANORM
MULT          57435         MULT
ENGS          57601         ENGS
STRES         60157         STRES
SHILL         60400         SHILL
AVSTRS        60522         AVSTRS
AEQ           60606         AEQ
ALINK         61467         ALINK
RANDOM.       62011         FORUTL=
LINLIM.       62015
Q8NTRY.       62055         Q8NTRY=
FECCHR.       62166         COMIO=
FECPRT.       62206
FECMSK.       62245         FECMSK=
FEOFAL.       62306         FLTOUT=
```

ENTRY	ADDRESS	PROGRAM
FEOEOV.	62330	
FEOEXP.	62332	
FEORND.	62367	
FEOSCA.	62424	
FEOZRO.	62510	
END.	62646	FORSYS=
EXIT	62673	
STOP.	62675	
ABNORM.	62704	
SYSARG=	62734	
IOERR.	62753	
SYSEND.	62777	
SYP=5	63001	
CLSLNK.	63014	
SYSE3.	63043	
SYSERR.	63057	
SYST1A.	63121	
SYP=1	63125	
SYP=3	63201	
SYP=4	63207	
SYS=6	63234	
SYS2=	63260	
FECOPE.	63327	
FEIGNC.	63421	INCOM=
FEISBL.	63436	
FEINUM.	63457	
FEIFSG.	63470	
FEIBLK=	63533	
FEIBLK.	63543	
FEIFST.	63557	
ERRSET	63562	
FEIERR.	63572	
INPCI.	63740	INPC=
INPCR.	64021	
KOJPT.	64077	KODER=
KODWRT=	64537	
KOREP.	64544	
FEOL.	64554	OUTCOM=
FEOI.	64557	
FEOXFL.	64626	
FEOAFM.	64634	
FEOBLS.	64641	
FEOCNV.	64654	
FEOR1F.	64705	
FEOR10.	64711	
FEONTL.	64716	
CLOCK	64730	CLOCK=
TIME	64730	
DATE	64735	
JDATE	64742	
SECOND	64747	
GOTOER.	64762	GOTOER=
ALOG	64776	ALOG
ALOG10	65002	
ALOG.	65007	

ENTRY	ADDRESS	PROGRAM
ALOG10.	65027	
EXP	65071	EXP
EXP.	65107	
COS	65166	SINCOS=
SIN	65171	
COS.	65174	
SIN.	65204	
SYSAID=	65253	SYSAID=
FEIEXP.	65254	FLTIN=
FEIFSC.	65276	
FECNAP.	65440	FMTAP=
FECAP.	65446	
FECFMT.	65465	
FECFMU.	65470	
FECJP=	65573	
FECLP.	65574	
FECRP.	65617	
FECEE.	65634	
FECV.	65702	
FECBUG.	65711	
CBD.	66005	FORUTL=
BFN.	66012	
GETFIT.	66023	GETFIT=
NAME.	66060	
KRINIT.	66415	KRAKER=
OUTCI.	66505	OUTC=
OUTCR.	66603	
SQRT	66663	SQRT
SQRT.	66702	
SYS1ST.	66730	SYS=1ST
MORGUE.	66732	
XTOI.	67012	XTOI=
XTOY.	67022	XTOY=
RM.CIO	67035	CIO.RM
RM.RCLA	67045	
RM.RCLP	67052	
RM.SYS=	67065	
MOVE.RM	67104	MOVE.RM
MCT.RM	67171	MCT.RM
OSUB.RM	67417	OSUB.RM
OPEN.SQ	67524	OPEN.SQ
OPXX.SQ	67641	
OPEX.SQ	70006	OPEX.SQ
RLEQ.RM	70033	RLEQ.RM
CLSF.SQ	70104	CLSF.SQ
RSPT.SQ	70172	
CLSV.SQ	70246	CLSV.SQ
REW.SQ	70376	REW.SQ
GET.SQ	70456	GET.SQ
SKGT.SQ	70527	
GCNT.SQ	70566	
GXIT.SQ	70636	
GRTJ.SQ	70717	
AINI.SQ	70751	
ANBL.SQ	70756	

ENTRY	ADDRESS	PROGRAM
AMAC.SQ	70762	
OXIT.SQ	71463	
GET.Z	71510	Z.SQ
GET.S	71611	FSU.SQ
GET.U	71615	
GET.F	71617	
RMU.SQ	71623	
RMU0.SQ	71630	
RMU2.SQ	71650	
RMU1.SQ	71651	
ERR.RM	71775	ERR.RM
ERR1.RM	72001	
ERR2.RM	72157	
CHWR.SQ	72323	CHWR.SQ
PUT.SQ	72343	PUT.SQ
FLSH.SQ	73415	
WAR.SQ	73721	WAR.SQ
REPO.SQ	74120	
CLSF.RM	74201	CLSF.RM
PUT.I	74224	BTRT.SQ
PUT.K	74224	
PUT.E	74224	
BTRT.SQ	74224	
PUT.C	74224	
WEOP.SQ	74340	WEOX.SQ
WEOS.SQ	74345	
SKFL.SQ	74511	SKFL.SQ
SYS=	74562	SYS.RM
RCL=	74575	
WNB=	74601	
MSG=	74611	
OPEN.RM	74623	OPEN.RM

```
1
 PROPLEM NO=    1      CANTILEVER BOX

TIME USED IN SECONDS =     25.0150
    54    18    36    40    12     2     3     4     0     1     2     3     0     1     1     0
     0     0    15    10     8     1
     1     1     0     0     0     0     0     2     0
 0.          0.             .5000E+00 .5000E+00
                10.5000                   .3000                   0.0000                25.0000
                20.0000                 15.0000                    .1000
                30.0000                   .3000                   0.0000                10.0000
                10.0000                  8.0000                    .2600
  .3200E+02 .3500E+01 .2080E+000.             .9300E+00 .7250E-01 .5200E-02 .1040E-01
  .3200E+02 .3500E+01 .2080E+000.             .9300E+00 .7250E-01 .5200E-02 .1040E-01
  .3200E+02 .3500E+01 .2080E+000.             .9300E+00 .7250E-01 .5200E-02 .1040E-01
  .3200E+02 .3500E+01 .2080E+000.             .9300E+00 .7250E-01 .5200E-02 .1040E-01
  .3200E+02 .3500E+01 .2080E+000.             .9300E+00 .7250E-01 .5200E-02 .1040E-01
  .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
  .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
  .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
  .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
  .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
  .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
  .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
         166.0000            92.4000            6.0000            29.7000          3.9600
         166.0000            92.4000            6.0000            29.7000          3.9600
         166.0000            92.4000            6.0000            29.7000          3.9600
         166.0000            92.4000            6.0000            29.7000          3.9600
         166.0000            92.4000            6.0000            29.7000          3.9600
         139.0000            86.0000            4.9500            11.8600          4.6800
         139.0000            86.0000            4.9500            11.8600          4.6800
         139.0000            86.0000            4.9500            11.8600          4.6800
         139.0000            86.0000            4.9500            11.8600          4.6800
         139.0000            86.0000            4.9500            11.8600          4.6800
         139.0000            86.0000            4.9500            11.8600          4.6800
         139.0000            86.0000            4.9500            11.8600          4.6800
 0.          0.          0.
  .1000E+010.            0.
 0.          .1000E+010.
 0.          .3000E+02 .4500E+02-.4500E+02
     1  4 3     1     3     7     5 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     2  4 3     2     4     8     6 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     3  4 3     5     7    11     9 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     4  4 3     6     8    12    10 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     5  4 3     9    11    15    13 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     6  4 3    10    12    16    14 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     7  4 2    13    15    19    17 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     8  4 2    14    16    20    18 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     9  4 2    17    19    23    21 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    10  4 2    18    20    24    22 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    11  4 2    21    23    27    25 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    12  4 2    22    24    28    26 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    13  4 1    25    27    31    29 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    14  4 1    26    28    32    30 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    15  4 1    29    31    35    33 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    16  4 1    30    32    36    34 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    17  4 1    33    35    39    37 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    18  4 1    34    36    40    38 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    19  5 2     1     2     6     5 .1000E+02 .1000E-01
    20  5 2     3     4     8     7 .1000E+02 .1000E-01
    21  5 2     5     6    10     9 .1000E+02 .1000E-01
    22  5 2     7     8    12    11 .1000E+02 .1000E-01
    23  5 2     9    10    14    13 .1000E+02 .1000E-01
    24  5 2    11    12    16    15 .1000E+02 .1000E-01
    25  5 2    13    14    18    17 .1000E+02 .1000E-01
    26  5 2    15    16    20    19 .1000E+02 .1000E-01
    27  5 2    17    18    22    21 .1000E+02 .1000E-01
    28  5 2    19    20    24    23 .1000E+02 .1000E-01
    29  5 2    21    22    26    25 .1000E+02 .1000E-01
    30  5 2    23    24    28    27 .1000E+02 .1000E-01
    31  5 2    25    26    30    29 .1000E+02 .1000E-01
    32  5 2    27    28    32    31 .1000E+02 .1000E-01
    33  5 2    29    30    34    33 .1000E+02 .1000E-01
    34  5 2    31    32    36    35 .1000E+02 .1000E-01
    35  5 2    33    34    38    37 .1000E+02 .1000E-01
    36  5 2    35    36    40    39 .1000E+02 .1000E-01
    37  2 1     1     2     0     0 .1000E+02 .1000E-01
    38  2 1     3     4     0     0 .1000E+02 .1000E-01
    39  2 1     5     6     0     0 .1000E+02 .1000E-01
    40  2 1     7     8     0     0 .1000E+02 .1000E-01
    41  2 1     9    10     0     0 .1000E+02 .1000E-01
    42  2 1    11    12     0     0 .1000E+02 .1000E-01
```

```
43   2 1   13   14    0     0 .1000E+02 .1000E-01
44   2 1   15   16    0     0 .1000E+02 .1000E-01
45   2 1   17   18    0     0 .1000E+02 .1000E-01
46   2 1   19   20    0     0 .1000E+02 .1000E-01
47   2 1   21   22    0     0 .1000E+02 .1000E-01
48   2 1   23   24    0     0 .1000E+02 .1000E-01
49   2 1   25   26    0     0 .1000E+02 .1000E-01
50   2 1   27   28    0     0 .1000E+02 .1000E-01
51   2 1   29   30    0     0 .1000E+02 .1000E-01
52   2 1   31   32    0     0 .1000E+02 .1000E-01
53   2 1   33   34    0     0 .1000E+02 .1000E-01
54   2 1   35   36    0     0 .1000E+02 .1000E-01
   10.          0.          .7500E+00
   20.          0.          .5000E+00
   30.            .1000E+01 .7500E+00
   40.            .1000E+01 .5000E+00
    5 .1000E+010.           .7500E+00
    6 .1000E+010.           .5000E+00
    7 .1000E+01 .1000E+01 .7500E+00
    8 .1000E+01 .1000E+01 .5000E+00
    9 .2000E+010.           .7500E+00
   10 .2000E+010.           .5000E+00
   11 .2000E+01 .1000E+01 .7500E+00
   12 .2000E+01 .1000E+01 .5000E+00
   13 .3000E+010.           .7500E+00
   14 .3000E+010.           .5000E+00
   15 .3000E+01 .1000E+01 .7500E+00
   16 .3000E+01 .1000E+01 .5000E+00
   17 .4000E+010.           .7500E+00
   18 .4000E+010.           .5000E+00
   19 .4000E+01 .1000E+01 .7500E+00
   20 .4000E+01 .1000E+01 .5000E+00
   21 .5000E+010.           .7500E+00
   22 .5000E+010.           .5000E+00
   23 .5000E+01 .1000E+01 .7500E+00
   24 .5000E+01 .1000E+01 .5000E+00
   25 .6000E+010.           .7500E+00
   26 .6000E+010.           .5000E+00
   27 .6000E+01 .1000E+01 .7500E+00
   28 .6000E+01 .1000E+01 .5000E+00
   29 .7000E+010.           .7500E+00
   30 .7000E+010.           .5000E+00
   31 .7000E+01 .1000E+01 .7500E+00
   32 .7000E+01 .1000E+01 .5000E+00
   33 .8000E+010.           .7500E+00
   34 .8000E+010.           .5000E+00
   35 .8000E+01 .1000E+01 .7500E+00
   36 .8000E+01 .1000E+01 .5000E+00
   37 .9000E+010.           .7500E+00
   38 .9000E+010.           .5000E+00
   39 .9000E+01 .1000E+01 .7500E+00
   40 .9000E+01 .1000E+01 .5000E+00
  109   110   111   112   113   114   115   116   117   118   119   120
    4     2
 -.1000E+01     3     1-.1000E+01     3     3-.1000E+01     3     2
 -.1000E+01     3     4
 -.5000E+00     2     2-.5000E+00     2     4
```

GROSS POPULATION APPARENT POPULATION

7260 1986

STARTING ROW NUMBERS FOR EACH COLUMN

1	1	1	1	1	1	1	1	1	4
4	4	1	1	1	1	1	1	1	1
1	4	4	4	13	13	13	13	13	13
13	13	13	16	16	16	25	25	25	25
25	25	25	25	25	28	28	28	37	37
37	37	37	37	37	37	37	40	40	40
49	49	49	49	49	49	49	49	49	52
52	52	61	61	61	61	61	61	61	61
61	64	64	64	73	73	73	73	73	73
73	73	73	76	76	76	85	85	85	85
85	85	85	85	85	88	88	88	97	97
97	97	97	97	97	97	97	100	100	100

NUMBERS OF DIAGONAL ELEMENTS IN SINGLE ARRAYSTIFFNESS MATRIX

1	3	6	10	15	21	28	36	45	52
60	69	82	96	111	127	144	162	181	201
222	241	261	282	295	309	324	340	357	375
394	414	435	454	474	495	508	522	537	553
570	588	607	627	648	667	687	708	721	735
750	766	783	801	820	840	861	880	900	921
934	948	963	979	996	1014	1033	1053	1074	1093
1113	1134	1147	1161	1176	1192	1209	1227	1246	1266
1287	1306	1326	1347	1360	1374	1389	1405	1422	1440
1459	1479	1500	1519	1539	1560	1573	1587	1602	1618
1635	1653	1672	1692	1713	1732	1752	1773	1786	1800
1815	1831	1848	1866	1885	1905	1926	1945	1965	1986

TIME USED IN SECONDS = 25.4660

RELATIVE AREAS OF MEMBERS

.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000
.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000
.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000
.100000	.100000	.100000	.100000	.100000	.100000	1.000000	1.000000	1.000000	1.000000
1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
1.000000	1.000000	1.000000	1.000000						
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000		
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000		
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000		
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000		

WEIGHT-SKIN= 4.408608E+02 WEIGHT-S-PANELS= 8.791053E+01 WEIGHT-POSTS= 2.616385E+01 TOTAL-WEIGHT= 5.549352E+02
ELE SKIN= 17 ABASE= .4845E+01 ELE STRUCT= 35 CBASE= .8333E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 1 EQ CYCLE NO= 0 NSTBLTY= 0

TIME USED IN SECONDS = 29.0680

```
RELATIVE AREAS OF MEMBERS
 .083197    .083197    .241169    .241169    .397770    .397770    .438054    .438054    .559666    .559666
 .683194    .683194    .793629    .793629    .921358    .921358   1.000000   1.000000    .069126    .069126
 .069126    .069126    .069126    .069126    .069126    .069126    .069126    .069126    .069126    .069126
 .069126    .069126    .069126    .069126    .069126    .069126    .002064    .002064    .002064    .002064
 .002064    .002064    .002064    .002064    .002064    .002064    .002064    .002064    .002064    .002064
 .002064    .002064    .002064    .002064

 .036081    .036081    .105008    .105008    .173187    .173187    .220612    .220612    .281913    .281913
 .344131    .344131    .344543    .344543    .400159    .400159    .428330    .428330

 .017271    .017271    .043665    .043665    .068438    .068438    .071194    .071194    .087370    .087370
 .105769    .105769    .154835    .154835    .184564    .184564    .157994    .157994

 .014923    .014923    .046248    .046248    .078072    .078072    .073124    .073124    .095192    .095192
 .116647    .116647    .147126    .147126    .168318    .168318    .206838    .206838

 .014923    .014923    .046248    .046248    .078072    .078072    .073124    .073124    .095192    .095192
 .116647    .116647    .147126    .147126    .168318    .168318    .206838    .206838


WEIGHT-SKIN=  3.868514E+02     WEIGHT-S-PANELS=  1.512000E+01     WEIGHT-POSTS=  1.343570E-02     TOTAL-WEIGHT=  4.019848E+02
     ELE SKIN=   17       ABASE=      .3581E+00           ELE STRUCT=   20           CBASE=       .1206E+01
STRUCTURE NO=    1           NO OF LOADS=    2            CYCLE NO=    2         EQ CYCLE NO=     0              NSTBLTY=     0

TIME USED IN SECONDS =    32.7060

RELATIVE AREAS OF MEMBERS
 .079069    .083424    .236679    .238201    .391970    .392871    .401192    .402302    .513339    .514184
 .628313    .629009    .773069    .776353    .906351    .906605    .999809   1.000000    .232681    .232681
 .232681    .232681    .232681    .232681    .232681    .232681    .232681    .232681    .232681    .232681
 .232681    .232681    .232681    .232681    .232681    .232681    .008295    .008295    .008295    .008295
 .008295    .008295    .008295    .008295    .008295    .008295    .008295    .008295    .008295    .008295
 .008295    .008295    .008295    .008295

 .050607    .050902    .151635    .151725    .250960    .251013    .303045    .303137    .337640    .337710
 .474523    .474580    .496388    .496402    .578574    .578587    .624366    .624375

 .009746    .010092    .026503    .026593    .040240    .040292    .031512    .031576    .036565    .036635
 .045526    .045566    .095969    .095984    .121864    .121877    .085433    .085448

 .009358    .011215    .029270    .029942    .050385    .050783    .033318    .033794    .044557    .044920
 .054132    .054432    .092856    .092984    .102956    .103070    .145003    .145089

 .009358    .011215    .029270    .029942    .050385    .050783    .033318    .033794    .044557    .044920
 .054132    .054432    .092856    .092984    .102956    .103070    .145003    .145089


WEIGHT-SKIN=  9.062318E+01     WEIGHT-S-PANELS=  1.512000E+01     WEIGHT-POSTS=  1.604269E-02     TOTAL-WEIGHT=  1.057592E+02
     ELE SKIN=   17       ABASE=      .2802E+00           ELE STRUCT=   35           CBASE=       .3581E+00
STRUCTURE NO=    1           NO OF LOADS=    2            CYCLE NO=    3         EQ CYCLE NO=     0              NSTBLTY=     0

TIME USED IN SECONDS =    36.2890

RELATIVE AREAS OF MEMBERS
 .149769    .149769    .275128    .275196    .398806    .398826    .443758    .444051    .544019    .544236
 .646373    .646552    .768674    .769262    .893052    .893587    .999627   1.000000    .297358    .297358
 .297358    .297358    .297358    .297358    .297358    .297358    .297358    .297358    .297358    .297358
 .297358    .297358    .297358    .297358    .297358    .297358    .027922    .027922    .027922    .027922
 .027922    .027922    .027922    .027922    .027922    .027922    .027922    .027922    .027922    .027922
 .027922    .027922    .027922    .027922

 .062654    .062653    .188012    .188060    .311690    .311710    .356642    .356335    .456903    .457121
 .559257    .559436    .616179    .616181    .716392    .716395    .784011    .783998

 .029039    .029039    .029039    .029039    .029039    .029039    .029039    .029039    .029039    .029039
 .029039    .029039    .049942    .049985    .067441    .067481    .039485    .039501
```

```
.029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039
.029039   .029039   .051276   .051548   .054610   .054856   .088066   .088250

.029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039
.029039   .029039   .051276   .051548   .054610   .054856   .088066   .088250

WEIGHT-SKIN=  7.178065E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  4.225466E-02    TOTAL-WEIGHT=  8.694290E+01
    ELE SKIN=   17    ABASE=     .2391E+00        ELE STRUCT=   36        CBASE=     .2802E+00
STRUCTURE NO=    1      NO OF LOADS=    2          CYCLE NO=    4       EQ CYCLE NO=    0        NSTBLTY=    0

TIME USED IN SECONDS =    39.8340

RELATIVE AREAS OF MEMBERS
.168180   .168465   .301364   .309452   .450927   .451470   .483023   .483623   .591231   .531804
.700620   .701171   .786255   .786301   .894013   .894073   .999426  1.000000   .348290   .348290
.348290   .348290   .348290   .348290   .348290   .348290   .348290   .348290   .348290   .348290
.348290   .348290   .348290   .348290   .348290   .348290   .035656   .035656   .035656   .035656
.035656   .035656   .035656   .035656   .035656   .035656   .035656   .035656   .035656   .035656
.035656   .035656   .035656   .035656

.056934   .057218   .197717   .198206   .339680   .340224   .371777   .372376   .479984   .480558
.569373   .533924   .675009   .675055   .782767   .782827   .867169   .867167

.037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082
.037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082

.037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082
.037082   .037082   .037082   .037082   .037082   .037082   .047587   .047875

.037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082
.037082   .037082   .037082   .037082   .037082   .037082   .047587   .047875

WEIGHT-SKIN=  6.843983E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  4.606840E-02    TOTAL-WEIGHT=  8.360590E+01
    ELE SKIN=   17    ABASE=     .2237E+00        ELE STRUCT=   31        CBASE=     .2393E+00
STRUCTURE NO=    1      NO OF LOADS=    2          CYCLE NO=    5       EQ CYCLE NO=    0        NSTBLTY=    0

TIME USED IN SECONDS =    43.4890

RELATIVE AREAS OF MEMBERS
.180527   .180761   .319847   .319252   .457633   .458103   .489545   .490036   .595094   .535578
.701487   .701357   .797782   .796046   .905134   .905408   .999943  1.000000   .369640   .369640
.369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640
.369640   .369640   .369640   .369640   .369640   .369640   .041467   .041467   .041467   .041467
.041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467
.041467   .041467   .041467   .041467

.051149   .051383   .189469   .189674   .328255   .328725   .360167   .360658   .465716   .466200
.572108   .572579   .668403   .668666   .775756   .776030   .870565   .870622

.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

.043126,  .043126   .043125   .043126   .043126   .043126   .043126   .043126   .043126   .043126
.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

WEIGHT-SKIN=  6.736409E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  5.048243E-02    TOTAL-WEIGHT=  8.253458E+01
    ELE SKIN=   17    ABASE=     .2235E+00        ELE STRUCT=   35        CBASE=     .2254E+00
STRUCTURE NO=    1      NO OF LOADS=    2          CYCLE NO=    6       EQ CYCLE NO=    0        NSTBLTY=    0

TIME USED IN SECONDS =    47.1700
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RELATIVE AREAS OF MEMBERS
 .183956   .184135   .321726   .321040   .457885   .458262   .491083   .491487   .595420   .535826
 .700612   .701012   .794674   .794905   .900552   .900786   .999775  1.000000   .369339   .369339
 .369339   .369339   .369339   .369339   .369339   .369339   .369339   .369339   .369339   .369339
 .369339   .369339   .369339   .369339   .369339   .369339   .043932   .043932   .043932   .043932
 .043932   .043932   .043932   .043932   .043932   .043932   .043932   .043932   .043932   .043932
 .043932   .043932   .043932   .043932

 .046889   .047068   .183659   .183973   .320818   .321195   .354017   .354420   .458353   .458759
 .563545   .563346   .657608   .657839   .763485   .763719   .862709   .862934

 .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689
 .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689

 .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689
 .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689

 .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689
 .045689   .045689   .045689   .045689   .045689   .045689   .045689   .045689

WEIGHT-SKIN=  6.829636E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  5.352591E-02    TOTAL-WEIGHT=  8.346989E+01
    ELE SKIN=   17     ABASE=  .2249E+00     ELE STRUCT=   32     CBASE=  .2256E+00
STRUCTURE NO=    1     NO OF LOADS=    2     CYCLE NO=    7     EQ CYCLE NO=    0     NSTBLTY=    0

TIME USED IN SECONDS =    50.8523

RELATIVE AREAS OF MEMBERS
 .182697   .182697   .311187   .319463   .456673   .457013   .490811   .491182   .595354   .535731
 .700795   .701171   .794273   .794487   .900400   .900616   .999783  1.000000   .367097   .367097
 .367097   .367097   .367097   .367097   .367097   .367097   .367097   .367097   .367097   .367097
 .367097   .367097   .367097   .367097   .367097   .367097   .043918   .043918   .043918   .043918
 .043918   .043918   .043918   .043918   .043918   .043918   .043918   .043918   .043918   .043918
 .043918   .043918   .043918   .043918

 .045674   .045674   .182164   .182440   .319650   .319990   .353789   .354159   .458331   .458708
 .563773   .564148   .657251   .657464   .763377   .763593   .862760   .862977

 .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674
 .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674

 .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674
 .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674

 .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674
 .045674   .045674   .045674   .045674   .045674   .045674   .045674   .045674

WEIGHT-SKIN=  6.855708E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  5.383573E-02    TOTAL-WEIGHT=  8.373091E+01
    ELE SKIN=   17     ABASE=  .2249E+00     ELE STRUCT=   23     CBASE=  .2270E+00
STRUCTURE NO=    1     NO OF LOADS=    2     CYCLE NO=    8     EQ CYCLE NO=    0     NSTBLTY=    0

TIME USED IN SECONDS =    54.5490

RELATIVE AREAS OF MEMBERS
 .181616   .181616   .311377   .318648   .456079   .456414   .490327   .490697   .594971   .535348
 .700520   .700896   .794063   .794276   .900301   .900518   .999783  1.000000   .367170   .367170
 .367170   .367170   .367170   .367170   .367170   .367170   .367170   .367170   .367170   .367170
 .367170   .367170   .367170   .367170   .367170   .367170   .043658   .043658   .043658   .043658
 .043658   .043658   .043658   .043658   .043658   .043658   .043658   .043658   .043658   .043658
 .043658   .043658   .043658   .043656

 .045404   .045404   .182165   .182436   .319867   .320202   .354115   .354485   .458759   .459136
 .564308   .564684   .657851   .658064   .764090   .764306   .863571   .863788

 .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404
 .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404
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.045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404
.045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404

.045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404
.045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404

WEIGHT-SKIN=  6.837103E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  5.350642E-02    TOTAL-WEIGHT=  8.354459E+01
    ELE SKIN=  17     ABASE=      .2248E+00         ELE STRUCT=  27          CBASE=      .2270E+00
STRUCTURE NO=   1        NO OF LOADS=   2            CYCLE NO=   9          EQ CYCLE NO=    0           NSTBLTY=    0

TIME USED IN SECONDS =    56.1760

RELATIVE AREAS OF MEMBERS
.180527   .180761   .313347   .319252   .457633   .458103   .489545   .490036   .595094   .535578
.701487   .701957   .797762   .796046   .905134   .905408   .999943  1.000000   .369640   .369640
.369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640
.369640   .369640   .369640   .369640   .369640   .369640   .041467   .369640   .041467   .041467
.041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467
.041467   .041467   .041467   .041467                                         .041467

.051149   .051383   .183469   .189874   .328255   .328725   .360167   .360658   .465716   .466200
.572108   .572579   .663403   .668668   .775756   .776030   .870565   .870622

.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
.043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

WEIGHT-SKIN=  6.736409E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  5.048243E-02    TOTAL-WEIGHT=  8.253458E+01
    ELE SKIN=  17     ABASE=      .2235E+00         ELE STRUCT=  21          CBASE=      .2254E+00
STRUCTURE NO=   1        NO OF LOADS=   2            CYCLE NO=  10          EQ CYCLE NO=    0           NSTBLTY=    0

TIME USED IN SECONDS =    51.8110

RELATIVE AREAS OF MEMBERS
.184296   .184296   .265716   .229470   .362782   .297713   .325985   .353352   .383457   .417012
.439430   .430954   .773777   .538090   .879122   .602241  1.000000   .664170   .372453   .372453
.372453   .372453   .372453   .372453   .372453   .372453   .372453   .372453   .372453   .372453
.372453   .372453   .372453   .372453   .372453   .372453   .044302   .044302   .044302   .044302
.044302   .044302   .044302   .044302   .044302   .044302   .044302   .044302   .044302   .044302
.044302   .044302   .044302   .044302

.046074   .046074   .127494   .091247   .224560   .159491   .187763   .215130   .245235   .278789
.301208   .342732   .640554   .399668   .740900   .464019   .861778   .525948

.046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074
.046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074

.046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074
.046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074

.046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074
.046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074

WEIGHT-SKIN=  5.611572E+01    WEIGHT-S-PANELS=  1.520566E+01    WEIGHT-POSTS=  5.382916E-02    TOTAL-WEIGHT=  7.137521E+01
    ELE SKIN=  17     ABASE=      .2250E+00         ELE STRUCT=  33          CBASE=      .2237E+00
STRUCTURE NO=   1        NO OF LOADS=   2            CYCLE NO=  11          EQ CYCLE NO=    1           NSTBLTY=    0

TIME USED IN SECONDS =    65.4440
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RELATIVE AREAS OF MEMBERS
 .184870   .184870   .258576   .218701   .354317   .286052   .319663   .348353   .375620   .411776
 .434230   .475878   .774244   .528507   .879173   .592890  1.000000   .653637   .370170   .370170
 .370170   .370170   .370170   .370170   .370170   .370170   .370170   .370170   .370170   .370170
 .370170   .370170   .370170   .370170   .370170   .370170   .044440   .044440   .044440   .044440
 .044440   .044440   .044440   .044440   .044440   .044440   .044440   .044440   .044440   .044440
 .044440   .044440   .044440   .044440

 .046218   .046218   .113923   .080049   .215664   .147400   .181010   .209701   .237167   .273123
 .295578   .337225   .635591   .389855   .740520   .454237   .861347   .514385

 .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218
 .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218

 .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218
 .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218

 .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218
 .046218   .046218   .046218   .046218   .046218   .046218   .046218   .046218

WEIGHT-SKIN=  5.536520E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  5.402369E-02    TOTAL-WEIGHT=  7.053922E+01
    ELE SKIN=  17     ABASE=      .2251E+00      ELE STRUCT=  35      CBASE=       .2251E+00
STRUCTURE NO=   1       NO OF LOADS=    2         CYCLE NO=  12      EQ CYCLE NO=    2        NSTBLTY=    0

TIME USED IN SECONDS =    69.1290

RELATIVE AREAS OF MEMBERS
 .184789   .184789   .257206   .216064   .353230   .284249   .319044   .347369   .375257   .411405
 .433824   .475594   .773932   .527776   .879103   .592293  1.000000   .652962   .370217   .370217
 .370217   .370217   .370217   .370217   .370217   .370217   .370217   .370217   .370217   .370217
 .370217   .370217   .370217   .370217   .370217   .370217   .044420   .044420   .044420   .044420
 .044420   .044420   .044420   .044420   .044420   .044420   .044420   .044420   .044420   .044420
 .044420   .044420   .044420   .044420

 .046197   .046197   .113614   .077473   .214638   .145657   .180452   .209377   .236665   .272313
 .295232   .337002   .635335   .389184   .740461   .453701   .861347   .514370

 .046197   .046197   .046197   .046197   .046197   .046197   .046197   .046197   .046197   .046197
 .046197   .046197   .046199   .046197   .046214   .046197   .046218   .046197

 .046197   .046197   .046197   .046197   .046197   .046197   .046197   .046197   .046197   .046197
 .046197   .046197   .046199   .046197   .046214   .046197   .046218   .046197

 .046197   .046197   .046197   .046197   .046197   .046197   .046197   .046197   .046197   .046197
 .046197   .046197   .046199   .046197   .046214   .046197   .046218   .046197

WEIGHT-SKIN=  5.521438E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  5.399312E-02    TOTAL-WEIGHT=  7.038888E+01
    ELE SKIN=  17     ABASE=      .2251E+00      ELE STRUCT=  19      CBASE=       .2251E+00
STRUCTURE NO=   1       NO OF LOADS=    2         CYCLE NO=  13      EQ CYCLE NO=    3        NSTBLTY=    0

TIME USED IN SECONDS =    72.7470

RELATIVE AREAS OF MEMBERS
 .184813   .184813   .257003   .215424   .353136   .284024   .319023   .347979   .375249   .411412
 .433829   .475610   .773942   .527760   .879102   .592293  1.000000   .652956   .370218   .370218
 .370218   .370218   .370218   .370218   .370218   .370218   .370218   .370218   .370218   .370218
 .370218   .370218   .370218   .370218   .370218   .370218   .044426   .044426   .044426   .044426
 .044426   .044426   .044426   .044426   .044426   .044426   .044426   .044426   .044426   .044426
 .044426   .044426   .044426   .044426

 .046203   .046203   .113393   .076814   .214526   .145415   .180413   .209369   .236639   .272802
 .295219   .337001   .635333   .389150   .740461   .453684   .861347   .514349

 .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203
 .046203   .046203   .046203   .046203   .046214   .046203   .046218   .046203

 .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203
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   .046203    .046203    .046203    .046203    .046214    .046203    .046218    .046203

   .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203
   .046203    .046203    .046203    .046203    .046214    .046203    .046218    .046203


  WEIGHT-SKIN=  5.519660E+01     WEIGHT-S-PANELS=  1.512000E+01     WEIGHT-POSTS=  5.399996E-02     TOTAL-WEIGHT=  7.037060E+01
      ELE SKIN=   17     ABASE=        .2251E+00         ELE STRUCT=   24          CBASE=        .2251E+00
  STRUCTURE NO=    1          NO OF LOADS=     2          CYCLE NO=   14          EQ CYCLE NO=     4          NSTBLTY=     0

TIME USED IN SECONDS =    76.3830

   RELATIVE AREAS OF MEMBERS
   .184813    .184813    .256961    .215244    .353118    .283990    .319017    .347977    .375245    .411409
   .433826    .475608    .773940    .527754    .879102    .592289   1.000000    .652953    .370218    .370218
   .370218    .370218    .370218    .370218    .370218    .370218    .370218    .370218    .370218    .370218
   .370218    .370218    .370218    .370218    .370218    .370218    .044426    .044426    .044426    .044426
   .044426    .044426    .044426    .044426    .044426    .044426    .044426    .044426    .044426    .044426
   .044426    .044426    .044426    .044426

   .046203    .046203    .118351    .076635    .214509    .145381    .180408    .209368    .236636    .272800
   .295216    .336999    .635330    .389145    .740461    .453680    .861347    .514344

   .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203
   .046203    .046203    .046203    .046203    .046214    .046203    .046218    .046203

   .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203
   .046203    .046203    .046203    .046203    .046214    .046203    .046218    .046203

   .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203
   .046203    .046203    .046203    .046203    .046214    .046203    .046218    .046203


  WEIGHT-SKIN=  5.519166E+01     WEIGHT-S-PANELS=  1.512000E+01     WEIGHT-POSTS=  5.400000E-02     TOTAL-WEIGHT=  7.036566E+01
      ELE SKIN=   17     ABASE=        .2251E+00         ELE STRUCT=   27          CBASE=        .2251E+00
  STRUCTURE NO=    1          NO OF LOADS=     2          CYCLE NO=   15          EQ CYCLE NO=     5          NSTBLTY=     0

TIME USED IN SECONDS =    80.0340

   RELATIVE AREAS OF MEMBERS
   .184813    .184813    .256953    .215195    .353116    .283987    .319017    .347977    .375245    .411409
   .433826    .475608    .773939    .527754    .879102    .592289   1.000000    .652953    .370218    .370218
   .370218    .370218    .370218    .370218    .370218    .370218    .370218    .370218    .370218    .370218
   .370218    .370218    .370218    .370218    .370218    .370218    .044426    .044426    .044426    .044426
   .044426    .044426    .044426    .044426    .044426    .044426    .044426    .044426    .044426    .044426
   .044426    .044426    .044426    .044426

   .046203    .046203    .118344    .076586    .214506    .145378    .180408    .209368    .236635    .272799
   .295216    .336999    .635330    .389144    .740461    .453680    .861347    .514343

   .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203
   .046203    .046203    .046203    .046203    .046214    .046203    .046218    .046203

   .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203
   .046203    .046203    .046203    .046203    .046214    .046203    .046218    .046203

   .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203    .046203
   .046203    .046203    .046203    .046203    .046214    .046203    .046218    .046203


  WEIGHT-SKIN=  5.519061E+01     WEIGHT-S-PANELS=  1.512002E+01     WEIGHT-POSTS=  5.400006E-02     TOTAL-WEIGHT=  7.036463E+01
      ELE SKIN=    6     ABASE=        .2251E+00         ELE STRUCT=   20          CBASE=        .2251E+00
  STRUCTURE NO=    1          NO OF LOADS=     2          CYCLE NO=   16          EQ CYCLE NO=     6          NSTBLTY=     0

TIME USED IN SECONDS =    83.6960

   RELATIVE AREAS OF MEMBERS
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 .164813     .184813     .256953     .215195     .353116     .283987     .319017     .347977     .375245     .411409
 .433826     .475608     .773339     .527754     .879102     .592289    1.000000     .652953     .370218     .370218
 .370218     .370218     .370218     .370218     .370218     .370218     .370218     .370218     .370218     .370218
 .370218     .370218     .370218     .370218     .370218     .370218     .044426     .044426     .044426     .044426
 .044426     .044426     .044426     .044426     .044426     .044426     .044426     .044426     .044426     .044426
 .044426     .044426     .044426     .044426
                                     .044426

 .046203     .046203     .113344     .076586     .214506     .145378     .180408     .209368     .236635     .272799
 .295216     .336999     .635330     .369144     .740461     .453680     .861347     .514343

 .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203
 .046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

 .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203
 .046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

 .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203
 .046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

L=   1  BASEA=  .14995E+00  L-C= 1  CRI= 2  LAR=  2  PRCNT=   .250    .250    .250    .250
L=   2  BASEA=  .10935E+00  L-C= 1  CRI= 1  LAR=  1  PRCNT=   .250    .250    .250    .250
L=   3  BASEA=  .22509E+00  L-C= 1  CRI= 2  LAR=  2  PRCNT=   .461    .180    .180    .180
L=   4  BASEA=  .22505E+00  L-C= 1  CRI= 1  LAR=  1  PRCNT=   .356    .215    .215    .215
L=   5  BASEA=  .22509E+00  L-C= 1  CRI= 2  LAR=  2  PRCNT=   .607    .131    .131    .131
L=   6  BASEA=  .22509E+00  L-C= 1  CRI= 1  LAR=  1  PRCNT=   .512    .163    .163    .163
L=   7  BASEA=  .22509E+00  L-C= 1  CRI= 2  LAR=  2  PRCNT=   .566    .145    .145    .145
L=   8  BASEA=  .22509E+00  L-C= 1  CRI= 1  LAR=  1  PRCNT=   .602    .133    .133    .133
L=   9  BASEA=  .22509E+00  L-C= 1  CRI= 2  LAR=  2  PRCNT=   .631    .123    .123    .123
L=  10  BASEA=  .22509E+00  L-C= 1  CRI= 1  LAR=  1  PRCNT=   .663    .112    .112    .112
L=  11  BASEA=  .22509E+00  L-C= 1  CRI= 2  LAR=  2  PRCNT=   .680    .107    .107    .107
L=  12  BASEA=  .22509E+00  L-C= 1  CRI= 1  LAR=  1  PRCNT=   .709    .097    .097    .097
L=  13  BASEA=  .22509E+00  L-C= 1  CRI= 2  LAR=  2  PRCNT=   .821    .060    .060    .060
L=  14  BASEA=  .22509E+00  L-C= 1  CRI= 1  LAR=  1  PRCNT=   .737    .088    .088    .088
L=  15  BASEA=  .22509E+00  L-C= 1  CRI= 2  LAR=  2  PRCNT=   .842    .053    .053    .053
L=  16  BASEA=  .22509E+00  L-C= 1  CRI= 1  LAR=  1  PRCNT=   .766    .078    .078    .078
L=  17  BASEA=  .22509E+00  L-C= 1  CRI= 2  LAR=  2  PRCNT=   .861    .046    .046    .046
L=  18  BASEA=  .22509E+00  L-C= 1  CRI= 1  LAR=  1  PRCNT=   .788    .071    .071    .071
L=  19  BASEA=  .22509E+00  L-C= 1
L=  20  BASEA=  .22509E+00  L-C= 1
L=  21  BASEA=  .22509E+00  L-C= 1
L=  22  BASEA=  .22509E+00  L-C= 1
L=  23  BASEA=  .22509E+00  L-C= 1
L=  24  BASEA=  .22509E+00  L-C= 1
L=  25  BASEA=  .22509E+00  L-C= 1
L=  26  BASEA=  .22509E+00  L-C= 1
L=  27  BASEA=  .22509E+00  L-C= 1
L=  28  BASEA=  .22509E+00  L-C= 1
L=  29  BASEA=  .22509E+00  L-C= 1
L=  30  BASEA=  .22509E+00  L-C= 1
L=  31  BASEA=  .22509E+00  L-C= 1
L=  32  BASEA=  .22509E+00  L-C= 1
L=  33  BASEA=  .22509E+00  L-C= 1
L=  34  BASEA=  .22509E+00  L-C= 1
L=  35  BASEA=  .22509E+00  L-C= 1
L=  36  BASEA=  .22509E+00  L-C= 1
L=  37  BASEA=  .95238E-05  L-C= 1
L=  38  BASEA=  .95238E-05  L-C= 1
L=  39  BASEA=  .95238E-05  L-C= 1
L=  40  BASEA=  .95238E-05  L-C= 1
L=  41  BASEA=  .95238E-05  L-C= 1
L=  42  BASEA=  .95238E-05  L-C= 1
L=  43  BASEA=  .95238E-05  L-C= 1
L=  44  BASEA=  .95238E-05  L-C= 1
L=  45  BASEA=  .95238E-05  L-C= 1
L=  46  BASEA=  .95238E-05  L-C= 1
L=  47  BASEA=  .95238E-05  L-C= 1
L=  48  BASEA=  .95238E-05  L-C= 1
L=  49  BASEA=  .95238E-05  L-C= 1
L=  50  BASEA=  .95238E-05  L-C= 1
L=  51  BASEA=  .95238E-05  L-C= 1
L=  52  BASEA=  .95238E-05  L-C= 1
L=  53  BASEA=  .95238E-05  L-C= 1
L=  54  BASEA=  .95238E-05  L-C= 1

WEIGHT-SKIN=  5.519061E+01     WEIGHT-S-PANELS=  1.512002E+01     WEIGHT-POSTS=  5.400006E-02     TOTAL-WEIGHT=  7.036463E+01
      ELE SKI =     6        ABASE=       .2251E+00           ELE STRUCT=   20              CBASE=        .2251E+00
STRUCTURE NO=     1                NO OF LOADS=      2        CYCLE NO=    17          EQ CYCLE NO=      6           NSTBLTY=     0
                                MINIMUM WEIGHT CYCLE=      16
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*****S T R E S S E S*****

MEMB    1  NODES    1    3    7    5  AREA .1440E+03  THICK.4160E-01  LAYER(THICK) .1040E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.3218E+03 .4136E+05-.4765E-08 2 -.1324E+05 .3298E+04 .5970E-07 3  .5824E+04 .9725E+04 .6286E+04 4  .5824E+04 .9725E+04-.6286E+04
2 1 -.2018E-10-.3069E-08 .6884E-10 2  .4702E-09-.2548E-09 .6884E-10 3 -.1422E-09-.3951E-09-.6728E-10 4 -.1042E-08-.1294E-08 .1094E-08
NODAL FORCES
1 -.4000E+04  .2136E-08 0.          -.4000E+04 -.1255E-09 0.          .4000E+04 -.2383E+03 0.          .4000E+04  .2383E+03 0.
2 -.3958E-09 -.5763E-10 0.           .1021E-08 -.8774E-10 0.         -.8760E-09 -.3838E-11 0.          .2504E-09  .1492E-09 0.

MEMB    2  NODES    2    4    8    6  AREA .1440E+03  THICK.4160E-01  LAYER(THICK) .1040E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .4377E+03-.4178E+05 .5316E-08 2  .1468E+05-.3305E+04-.6588E-07 3 -.5475E+04-.9509E+04-.6058E+04 4 -.5475E+04-.9509E+04 .6058E+04
2 1  .1930E-08 .7140E-08 .4735E+03 2 -.4201E-07 .6750E-09 .4735E+03 3  .3094E+04 .3094E+04 .3533E+04 4 -.3094E+04-.3094E+04 .3533E+04
NODAL FORCES
1  .4000E+04 -.1603E-08 0.           .4000E+04 -.3438E-09 0.         -.4000E+04  .5200E+03 0.         -.4000E+04 -.5200E+03 0.
2 -.2736E-08 -.5000E+03 0.          -.1164E-08 -.5000E+03 0.          .1000E+04  .5000E+03 0.         -.1000E+04  .5000E+03 0.

MEMB    3  NODES    5    7   11    9  AREA .1440E+03  THICK.5784E-01  LAYER(THICK) .2664E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.2067E+03 .6130E+05-.7727E-08 2 -.1648E+05 .4950E+04 .7326E-07 3  .9613E+04 .1517E+05 .1002E+05 4  .9613E+04 .1517E+05-.1002E+05
2 1  .2687E-11 .2254E-07-.2042E-09 2 -.5143E-08 .1638E-08-.2042E-09 3  .2485E-08 .4463E-08 .2365E-08 4  .5153E-08 .7131E-08-.5411E-08
NODAL FORCES
1 -.1200E+05 -.2383E+03 0.          -.1200E+05  .2383E+03 0.          .1200E+05  .3860E+02 0.          .1200E+05 -.3860E+02 0.
2 -.4847E-08 -.2926E-09 0.          -.4033E-08  .7635E-09 0.          .3562E-08 -.4513E-09 0.          .5318E-08 -.1964E-10 0.

MEMB    4  NODES    6    8   12   10  AREA .1440E+03  THICK.4844E-01  LAYER(THICK) .1724E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .2421E+03-.8598E+05 .7490E-08 2  .2256E+05-.6954E+04-.1035E-06 3 -.1366E+05-.2141E+05-.1418E+05 4 -.1366E+05-.2141E+05 .1418E+05
2 1  .8715E-09-.2134E-07 .4558E+03 2 -.4544E-07-.1677E-08 .4558E+03 3  .2978E+04 .2978E+04 .3401E+04 4 -.2978E+04-.2978E+04 .3401E+04
NODAL FORCES
1  .1200E+05  .5200E+03 0.           .1200E+05 -.5200E+03 0.         -.1200E+05 -.2359E+02 0.         -.1200E+05  .2359E+02 0.
2  .1000E+04 -.5000E+03 0.          -.1000E+04 -.5000E+03 0.          .2000E+04  .5000E+03 0.         -.2000E+04  .5000E+03 0.

MEMB    5  NODES    9   11   15   13  AREA .1440E+03  THICK.7948E-01  LAYER(THICK) .4828E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.2756E+03 .6150E+05-.6738E-08 2 -.1732E+05 .4950E+04 .7819E-07 3  .9396E+04 .1503E+05 .9875E+04 4  .9396E+04 .1503E+05-.9875E+04
2 1 -.3385E-09 .3807E-07-.1492E-09 2 -.1268E-07 .3026E-08-.1492E-09 3  .4233E-08 .7860E-08 .4564E-08 4  .6183E-08 .9809E-08-.6791E-08
NODAL FORCES
1 -.2000E+05  .3860E+02 0.          -.2000E+05 -.3860E+02 0.          .2000E+05  .6222E+02 0.          .2000E+05 -.6222E+02 0.
2 -.2971E-07  .2569E-09 0.           .5072E-08  .1261E-09 0.         -.5455E-08 -.6043E-09 0.          .3010E-07  .2214E-09 0.

MEMB    6  NODES   10   12   16   14  AREA .1440E+03  THICK.6392E-01  LAYER(THICK) .3272E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .2206E+03-.8600E+05 .6231E-08 2  .2231E+05-.6960E+04-.1037E-06 3 -.1374E+05-.2148E+05-.1424E+05 4 -.1374E+05-.2148E+05 .1424E+05
2 1  .8084E-09-.4884E-07 .4202E+03 2 -.3511E-07-.4107E-08 .4202E+03 3  .2745E+04 .2745E+04 .3135E+04 4 -.2745E+04-.2745E+04 .3135E+04
NODAL FORCES
1  .2000E+05 -.2359E+02 0.           .2000E+05  .2359E+02 0.         -.2000E+05 -.5815E+03 0.         -.2000E+05  .5815E+03 0.
2  .2000E+04 -.5000E+03 0.          -.2000E+04 -.5000E+03 0.          .3000E+04  .5000E+03 0.         -.3000E+04  .5000E+03 0.

MEMB    7  NODES   13   15   19   17  AREA .1440E+03  THICK.7181E-01  LAYER(THICK) .4061E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.8925E+03 .1059E+06-.7071E-08 2 -.1620E+05 .4950E+04 .7477E-07 3  .9683E+04 .1522E+05 .1007E+05 4  .9683E+04 .1522E+05-.1007E+05
2 1 -.9738E-09 .1203E-06 .1752E-09 2 -.1820E-07 .5631E-08 .1225E-09 3  .1187E-07 .1815E-07 .1241E-07 4  .1027E-07 .1655E-07-.1058E-07
NODAL FORCES
1 -.2800E+05  .6222E+02 0.          -.2800E+05 -.6222E+02 0.          .2800E+05  .2206E+02 0.          .2800E+05 -.2206E+02 0.
2 -.9280E-07 -.5281E-09 0.           .2913E-07  .1993E-09 0.         -.2881E-07 -.1813E-09 0.          .9247E-07  .5100E-09 0.

MEMB    8  NODES   14   16   20   18  AREA .1440E+03  THICK.7833E-01  LAYER(THICK) .4713E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .1108E+04-.9240E+05 .5476E-08 2  .1589E+05-.4286E+04-.7386E-07 3 -.7907E+04-.1286E+05-.8397E+04 4 -.7907E+04-.1286E+05 .8397E+04
2 1  .2686E-08-.8695E-07 .5117E+03 2 -.2376E-07-.4126E-08 .3576E+03 3  .2336E+04 .2336E+04 .2668E+04 4 -.2336E+04-.2336E+04 .2668E+04
NODAL FORCES
1  .2800E+05 -.5815E+03 0.           .2800E+05  .5815E+03 0.         -.2800E+05  .5515E+02 0.         -.2800E+05 -.5515E+02 0.
2  .3000E+04 -.5000E+03 0.          -.3000E+04 -.5000E+03 0.          .4000E+04  .5000E+03 0.         -.4000E+04  .5000E+03 0.
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MEMB    9 NODES   17   19   23   21  AREA .1440E+03  THICK.8447E-01  LAYER(THICK) .5326E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.8263E+03 .1057E+06-.5897E-08 2 -.1584E+05 .4950E+04 .7388E-07 3  .9778E+04 .1528E+05 .1013E+05 4  .9778E+04 .1528E+05-.1013E+05
2 1 -.1317E-08 .1753E-06 .1558E-09 2 -.2598E-07 .8216E-08 .1089E-09 3  .1702E-07 .2612E-07 .1768E-07 4  .1560E-07 .2470E-07-.1606E-07
NODAL FORCES
1 -.3600E+05  .2206E+02 0.          -.3600E+05 -.2206E+02 0.           .3600E+05 -.4192E+02 0.           .3600E+05  .4192E+02 0.
2 -.1829E-06 -.6014E-09 0.           .6349E-07  .2854E-09 0.          -.6317E-07 -.2392E-09 0.           .1826E-06  .6151E-09 0.

MEMB   10 NODES   18   20   24   22  AREA .1440E+03  THICK.9261E-01  LAYER(THICK) .6141E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .6003E+03-.9240E+05 .4239E-08 2  .1319E+05-.4339E+04-.6221E-07 3 -.8748E+04-.1351E+05-.9000E+04 4 -.8748E+04-.1351E+05 .9000E+04
2 1  .2267E-08-.1374E-06 .4704E+03 2 -.1669E-07-.6555E-08 .3288E+03 3  .2148E+04 .2148E+04 .2453E+04 4 -.2148E+04-.2148E+04 .2453E+04
NODAL FORCES
1  .3600E+05  .5515E+02 0.           .3600E+05 -.5515E+02 0.          -.3600E+05 -.3947E+02 0.          -.3600E+05  .3947E+02 0.
2  .4000E+04 -.5000E+03 0.          -.4000E+04 -.5000E+03 0.           .5000E+04  .5000E+03 0.          -.5000E+04  .5000E+03 0.

MEMB   11 NODES   21   23   27   25  AREA .1440E+03  THICK.9765E-01  LAYER(THICK) .6645E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.3459E+03 .1047E+06-.4927E-08 2 -.1317E+05 .4950E+04 .6216E-07 3  .1046E+05 .1573E+05 .1059E+05 4  .1046E+05 .1573E+05-.1059E+05
2 1 -.5768E-09 .2194E-06 .2040E-09 2 -.2682E-07 .1039E-07 .1426E-09 3  .2311E-07 .3409E-07 .2344E-07 4  .2124E-07 .3223E-07-.2131E-07
NODAL FORCES
1 -.4400E+05 -.4192E+02 0.          -.4400E+05  .4192E+02 0.           .4400E+05  .6498E+03 0.           .4400E+05 -.6498E+03 0.
2 -.2905E-06 -.7442E-09 0.           .1060E-06  .2983E-09 0.          -.1056E-06  .1430E-08 0.           .2901E-06 -.3836E-09 0.

MEMB   12 NODES   22   24   28   26  AREA .1440E+03  THICK.1071E+00  LAYER(THICK) .7586E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .6698E+03-.9240E+05 .3858E-08 2  .1356E+05-.4332E+04-.6419E-07 3 -.8633E+04-.1342E+05-.8917E+04 4 -.8633E+04-.1342E+05 .8917E+04
2 1  .2703E-08-.1802E-06 .4350E+03 2 -.6448E-08-.8529E-08 .3040E+03 3  .1986E+04 .1986E+04 .2268E+04 4 -.1986E+04-.1986E+04 .2268E+04
NODAL FORCES
1  .4400E+05 -.3947E+02 0.           .4400E+05  .3947E+02 0.          -.4400E+05  .1081E+03 0.          -.4400E+05 -.1081E+03 0.
2  .5000E+04 -.5000E+03 0.          -.5000E+04 -.5000E+03 0.           .6000E+04  .5000E+03 0.          -.6000E+04  .5000E+03 0.

MEMB   13 NODES   25   27   31   29  AREA .1440E+03  THICK.1742E+00  LAYER(THICK) .1430E+00 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.6005E+03 .5813E+05-.3304E-08 2 -.1633E+05 .6000E+04 .8818E-07 3  .9595E+04 .1400E+05 .9099E+04 4  .9595E+04 .1400E+05-.9099E+04
2 1 -.1386E-08 .1401E-06 .1221E-09 2 -.3880E-07 .1447E-07 .1221E-09 3  .2424E-07 .3483E-07 .2317E-07 4  .2236E-07 .3295E-07-.2093E-07
NODAL FORCES
1 -.5200E+05  .6498E+03 0.          -.5200E+05 -.6498E+03 0.           .5200E+05 -.2424E+02 0.           .5200E+05  .2424E+02 0.
2 -.4064E-06  .3007E-09 0.           .1557E-06 -.1406E-08 0.          -.1552E-06  .1128E-12 0.           .4059E-06  .5051E-09 0.

MEMB   14 NODES   26   28   32   30  AREA .1440E+03  THICK.1188E+00  LAYER(THICK) .8759E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .7383E+03-.9240E+05 .5004E-08 2  .2398E+05-.9578E+04-.1311E-06 3 -.1587E+05-.2276E+05-.1490E+05 4 -.1587E+05-.2276E+05 .1490E+05
2 1  .3153E-08-.2121E-06 .2881E+03 2  .2172E-07-.2025E-07 .2881E+03 3  .2218E+04 .2218E+04 .2649E+04 4 -.2218E+04-.2218E+04 .2649E+04
NODAL FORCES
1  .5200E+05  .1081E+03 0.           .5200E+05 -.1081E+03 0.          -.5200E+05 -.8486E+02 0.          -.5200E+05  .8486E+02 0.
2  .6000E+04 -.5000E+03 0.          -.6000E+04 -.5000E+03 0.           .7000E+04  .5000E+03 0.          -.7000E+04  .5000E+03 0.

MEMB   15 NODES   29   31   35   33  AREA .1440E+03  THICK.1979E+00  LAYER(THICK) .1667E+00 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.4355E+03 .5784E+05-.2800E-08 2 -.1476E+05 .6000E+04 .8123E-07 3  .1001E+05 .1431E+05 .9377E+04 4  .1001E+05 .1431E+05-.9377E+04
2 1 -.1167E-08 .1535E-06 .1433E-09 2 -.3928E-07 .1592E-07 .1433E-09 3  .2763E-07 .3904E-07 .2618E-07 4  .2543E-07 .3684E-07-.2354E-07
NODAL FORCES
1 -.6000E+05 -.2424E+02 0.          -.6000E+05  .2424E+02 0.           .6000E+05 -.2389E+03 0.           .6000E+05  .2389E+03 0.
2 -.5282E-06 -.5998E-09 0.           .2098E-06 -.3379E-10 0.          -.2092E-06 -.5802E-09 0.           .5276E-06  .1214E-08 0.

MEMB   16 NODES   30   32   36   34  AREA .1440E+03  THICK.1333E+00  LAYER(THICK) .1021E+00 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .9158E+03-.9240E+05 .4329E-08 2  .2561E+05-.9545E+04-.1388E-06 3 -.1536E+05-.2235E+05-.1454E+05 4 -.1536E+05-.2235E+05 .1454E+05
2 1  .4042E-08-.2365E-06 .2743E+03 2  .3666E-07-.2273E-07 .2743E+03 3  .2112E+04 .2112E+04 .2522E+04 4 -.2112E+04-.2112E+04 .2522E+04
NODAL FORCES
1  .6000E+05 -.8486E+02 0.           .6000E+05  .8486E+02 0.          -.6000E+05  .3986E+03 0.          -.6000E+05 -.3986E+03 0.
2  .7000E+04 -.5000E+03 0.          -.7000E+04 -.5000E+03 0.           .8000E+04  .5000E+03 0.          -.8000E+04  .5000E+03 0.

MEMB   17 NODES   33   35   39   37  AREA .1440E+03  THICK.2251E+00  LAYER(THICK) .1939E+00 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .3538E+03 .5644E+05-.1604E-08 2 -.7257E+04 .6000E+04 .4681E-07 3  .1200E+05 .1577E+05 .1071E+05 4  .1200E+05 .1577E+05-.1071E+05
2 1  .1068E-08 .1601E-06 .1330E-09 2 -.1999E-07 .1703E-07 .1330E-09 3  .3524E-07 .4590E-07 .3172E-07 4  .3320E-07 .4386E-07-.2928E-07
NODAL FORCES
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1 -.6800E+05 -.2389E+03 0.           -.6800E+05  .2389E+03 0.           .6800E+05  .2674E+04 0.           .5800E+05 -.2674E+04 0.
2 -.6511E-06 -.1213E-08 0.            .2653E-06  .5816E-09 0.          -.2647E-06  .7951E-08 0.           .6505E-06 -.7320E-08 0.


MEMB   18  NODES   34   36   40   38  AREA .1440E+03  THICK.1470E+00  LAYER(THICK) .1158E+00 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.5109E+03-.9240E+05 .2707E-08 2  .1251E+05-.9810E+04-.7950E-07 3 -.1945E+05-.2566E+05-.1739E+05 4 -.1945E+05-.2566E+05 .1739E+05
2 1 -.5667E-09-.2545E-06 .2625E+03 2 -.4139E-09-.2553E-07 .2625E+03 3  .2021E+04 .2021E+04 .2414E+04 4 -.2021E+04-.2021E+04 .2414E+04
NODAL FORCES
1  .6800E+05  .3986E+03 0.           .6800E+05 -.3986E+03 0.          -.6800E+05 -.3605E+04 0.          -.6800E+05  .3605E+04 0.
2  .8000E+04 -.5000E+03 0.          -.8000E+04 -.5000E+03 0.           .9000E+04  .5000E+03 0.          -.9000E+04  .5000E+03 0.
MEMB   19  NODES    1    2    6    5  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.3211E-08
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2  .5588E-08 0.            -.1397E-08 -.5588E-08 0.          -.1397E-08 -.5588E-08 0.           .1397E-08  .5588E-08 0.           .1397E-08
MEMB   20  NODES    3    4    8    7  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .2578E-07
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2 -.7451E-08 0.             .1863E-08  .7451E-08 0.           .1863E-08  .7451E-08 0.          -.1863E-08 -.7451E-08 0.          -.1863E-08
MEMB   21  NODES    5    6   10    9  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.2223E-07
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2  .1304E-07 0.            -.3260E-08 -.1304E-07 0.          -.3260E-08 -.1304E-07 0.           .3260E-08  .1304E-07 0.           .3260E-08
MEMB   22  NODES    7    8   12   11  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .2022E-07
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2 -.1304E-07 0.             .3260E-08  .1304E-07 0.           .3260E-08  .1304E-07 0.          -.3260E-08 -.1304E-07 0.          -.3260E-08
MEMB   23  NODES    9   10   14   13  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.7138E-07
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2  .3632E-07 0.            -.9080E-08 -.3632E-07 0.          -.9080E-08 -.3632E-07 0.           .9080E-08  .3632E-07 0.           .9080E-08
MEMB   24  NODES   11   12   16   15  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .3983E-07
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2 -.1863E-07 0.             .4657E-08  .1863E-07 0.           .4657E-08  .1863E-07 0.          -.4657E-08 -.1863E-07 0.          -.4657E-08
MEMB   25  NODES   13   14   18   17  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.8496E-07
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2  .4191E-07 0.            -.1048E-07 -.4191E-07 0.          -.1048E-07 -.4191E-07 0.           .1048E-07  .4191E-07 0.           .1048E-07
MEMB   26  NODES   15   16   20   19  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .4485E-07
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2 -.2282E-07 0.             .5704E-08  .2282E-07 0.           .5704E-08  .2282E-07 0.          -.5704E-08 -.2282E-07 0.          -.5704E-08
MEMB   27  NODES   17   18   22   21  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.1078E-06
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2  .5309E-07 0.            -.1327E-07 -.5309E-07 0.          -.1327E-07 -.5309E-07 0.           .1327E-07  .5309E-07 0.           .1327E-07
MEMB   28  NODES   19   20   24   23  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .4728E-07
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2 -.2282E-07 0.             .5704E-08  .2282E-07 0.           .5704E-08  .2282E-07 0.          -.5704E-08 -.2282E-07 0.          -.5704E-08
MEMB   29  NODES   21   22   26   25  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.1131E-06
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2  .5658E-07 0.            -.1414E-07 -.5658E-07 0.          -.1414E-07 -.5658E-07 0.           .1414E-07  .5658E-07 0.           .1414E-07
MEMB   30  NODES   23   24   28   27  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .5265E-07
         NODAL FORCES
1  .4000E+04 0.            -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.           .1000E+04  .4000E+04 0.           .1000E+04
2 -.2584E-07 0.             .6461E-08  .2584E-07 0.           .6461E-08  .2584E-07 0.          -.6461E-08 -.2584E-07 0.          -.6461E-08
MEMB   31  NODES   25   26   30   29  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.1139E-06
         NODAL FORCES
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1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2  .6054E-07 0.        -.1513E-07 -.6054E-07 0.        -.1513E-07 -.6054E-07 0.        .1513E-07  .6054E-07 0.        .1513E-07
MEMB   32  NODES   27   28   32   31  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .5462E-07
        NODAL FORCES
1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2 -.2765E-07 0.         .6912E-08  .2765E-07 0.         .6912E-08  .2765E-07 0.       -.6912E-08 -.2765E-07 0.       -.6912E-08
MEMB   33  NODES   29   30   34   33  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.1226E-06
        NODAL FORCES
1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2  .6132E-07 0.        -.1533E-07 -.6132E-07 0.        -.1533E-07 -.6132E-07 0.        .1533E-07  .6132E-07 0.        .1533E-07
MEMB   34  NODES   31   32   36   35  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .5574E-07
        NODAL FORCES
1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2 -.2791E-07 0.         .6978E-08  .2791E-07 0.         .6978E-08  .2791E-07 0.       -.6978E-08 -.2791E-07 0.       -.6978E-08
MEMB   35  NODES   33   34   38   37  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.1231E-06
        NODAL FORCES
1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2  .6155E-07 0.        -.1539E-07 -.6155E-07 0.        -.1539E-07 -.6155E-07 0.        .1539E-07  .6155E-07 0.        .1539E-07
MEMB   36  NODES   35   36   40   39  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .5605E-07
        NODAL FORCES
1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2 -.2804E-07 0.         .7010E-08  .2804E-07 0.         .7010E-08  .2804E-07 0.       -.7010E-08 -.2804E-07 0.       -.7010E-08
MEMB   37  NODES    1    2  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .3948E-06 2  .1990E-06
NODAL FORCES
1 0.         0.         .1118E-07 0.         0.         -.1118E-07
2 0.         0.         .1863E-08 0.         0.         -.1863E-08
MEMB   38  NODES    3    4  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .1194E-05 2 -.1741E-06
NODAL FORCES
1 0.         0.         .1304E-07 0.         0.         -.1304E-07
2 0.         0.        -.1863E-08 0.         0.          .1863E-08
MEMB   39  NODES    5    6  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .5969E-06 2  .1243E-06
NODAL FORCES
1 0.         0.         .5588E-08 0.         0.         -.5588E-08
2 0.         0.         .1397E-08 0.         0.         -.1397E-08
MEMB   40  NODES    7    8  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .5969E-06 2 -.1243E-06
NODAL FORCES
1 0.         0.         .5588E-08 0.         0.         -.5588E-08
2 0.         0.        -.1164E-08 0.         0.          .1164E-08
MEMB   41  NODES    9   10  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .2984E-06 2  .6217E-07
NODAL FORCES
1 0.         0.         .2794E-08 0.         0.         -.2794E-08
2 0.         0.         .5821E-09 0.         0.         -.5821E-09
MEMB   42  NODES   11   12  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .3979E-06 2 -.4974E-07
NODAL FORCES
1 0.         0.         .3725E-08 0.         0.         -.3725E-08
2 0.         0.        -.4657E-09 0.         0.          .4657E-09
MEMB   43  NODES   13   14  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .1990E-06 2  .3730E-07
NODAL FORCES
1 0.       , 0.         .1863E-08 0.         0.         -.1863E-08
2 0.         0.         .3492E-09 0.         0.         -.3492E-09
MEMB   44  NODES   15   16  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .1990E-06 2 -.2487E-07
NODAL FORCES
1 0.         0.         .1863E-08 0.         0.         -.1863E-08
2 0.         0.        -.2328E-09 0.         0.          .2328E-09
MEMB   45  NODES   17   18  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .4974E-07 2  .1865E-07
NODAL FORCES
1 0.         0.         .4657E-09 0.         0.         -.4657E-09
2 0.         0.         .1746E-09 0.         0.         -.1746E-09
MEMB   46  NODES   19   20  LENGTH .3000E+01  AREA .1000E-01
STRESSES
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1   .1990E-06 2 -.2487E-07
NODAL FORCES
1 0.          0.          .1863E-08 0.          0.          -.1863E-08
2 0.          0.         -.2328E-09 0.          0.           .2328E-09
MEMB   47  NODES   21   22  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1   .1492E-06 2  .6217E-08
NODAL FORCFS
1 0.          0.          .1630E-08 0.          0.          -.1630E-08
2 0.          0.          .5821E-10 0.          0.          -.5821E-10
MEMB   48  NODES   23   24  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1   .7461E-07 2 -.1865E-07
NODAL FORCES
1 0.          0.          .6985E-09 0.          0.          -.6985E-09
2 0.          0.         -.1746E-09 0.          0.           .1746E-09
MEMB   49  NODES   25   26  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1   .2487E-07 2  .1554E-07
NODAL FORCES
1 0.          0.          .2328E-09 0.          0.          -.2328E-09
2 0.          0.          .1455E-09 0.          0.          -.1455E-09
MEMB   50  NODES   27   28  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1   .4974E-07 2 -.1554E-07
NODAL FORCES
1 0.          0.          .4657E-09 0.          0.          -.4657E-09
2 0.          0.         -.1455E-09 0.          0.           .1455E-09
MEMB   51  NODES   29   30  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1   .3109E-07 2  .6217E-08
NODAL FORCES
1 0.          0.          .3492E-09 0.          0.          -.3492E-09
2 0.          0.          .5821E-10 0.          0.          -.5821E-10
MEMB   52  NODES   31   32  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1   .3109E-07 2 -.7772E-08
NODAL FORCES
1 0.          0.          .3492E-09 0.          0.          -.3492E-09
2 0.          0.         -.8731E-10 0.          0.           .8731E-10
MEMB   53  NODES   33   34  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1   .4663E-08 2  .1166E-08
NODAL FORCES
1 0.          0.          .2910E-10 0.          0.          -.2910E-10
2 0.          0.          .1091E-10 0.          0.          -.1091E-10
MEMB   54  NODES   35   36  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1   .6217E-08 2 -.1166E-08
NODAL FORCES
1 0.          0.          .8731E-10 0.          0.          -.8731E-10
2 0.          0.         -.1091E-10 0.          0.           .1091E-10
```

*****DISPLACEMENTS*****

JOINT	-X	-Y	-Z
1	0.000	0.000	9.000
2	0.000	0.000	6.000
3	0.000	12.000	9.000
4	0.000	12.000	6.000
5	12.000	0.000	9.000
6	12.000	0.000	6.000
7	12.000	12.000	9.000
8	12.000	12.000	6.000
9	24.000	0.000	9.000
10	24.000	0.000	6.000
11	24.000	12.000	9.000
12	24.000	12.000	6.000
13	36.000	0.000	9.000
14	36.000	0.000	6.000
15	36.000	12.000	9.000
16	36.000	12.000	6.000
17	48.000	0.000	9.000
18	48.000	0.000	6.000
19	48.000	12.000	9.000
20	48.000	12.000	6.000
21	60.000	0.000	9.000
22	60.000	0.000	6.000
23	60.000	12.000	9.000
24	60.000	12.000	6.000
25	72.000	0.000	9.000
26	72.000	0.000	6.000
27	72.000	12.000	9.000
28	72.000	12.000	6.000
29	84.000	0.000	9.000
30	84.000	0.000	6.000
31	84.000	12.000	9.000
32	84.000	12.000	6.000
33	96.000	0.000	9.000
34	96.000	0.000	6.000
35	96.000	12.000	9.000

FORCE-X	FORCE-Y	FORCE-Z	DISPL-X	DISPL-Y	DISPL-Z
0.000	0.000	-1000.000	-2.90095213E-01	3.86149529E-03	-1.07835986E+01
0.000	0.000	0.000	-2.02038625E-12	1.92863466E-11	-1.43200009E+00
0.000	0.000	-1000.000	3.47024027E-01	-3.50328835E-03	-1.07835986E+01
0.000	-500.000	0.000	8.22862698E-02	-7.69843973E-01	-1.43200009E+00
0.000	0.000	-1000.000	-2.90095213E-01	-3.86149515E-03	-1.07835986E+01
0.000	0.000	0.000	1.21839519E-12	1.92870540E-11	1.43200009E+00
0.000	0.000	-1000.000	3.47024027E-01	3.50328818E-03	-1.07835986E+01
0.000	-500.000	0.000	-8.22862698E-02	-7.69843973E-01	1.43200009E+00
0.000	0.000	0.000	-2.63208732E-01	5.26119190E-03	-3.33493412E+00
0.000	0.000	0.000	-2.01490466E-12	1.60566664E-11	-1.11460114E+00
0.000	0.000	0.000	3.19844267E-01	-6.55736956E-03	-8.33493412E+00
0.000	0.000	0.000	7.64132081E-02	-6.02402628E-01	-1.11460114E+00
0.000	0.000	0.000	-2.63208732E-01	-5.26119179E-03	-8.33493411E+00
0.000	0.000	0.000	1.20893805E-12	1.60566518E-11	1.11460114E+00
0.000	0.000	0.000	3.19844267E-01	6.55736942E-03	-8.33493411E+00
0.000	0.000	0.000	-7.64132081E-02	-6.02402628E-01	1.11460114E+00
0.000	0.000	0.000	-2.23398960E-01	6.23334525E-03	-6.18568511E+00
0.000	0.000	0.000	-1.99629980E-12	1.28366582E-11	-8.34545363E-01
0.000	0.000	0.000	2.64012549E-01	-9.20694330E-03	-6.18568511E+00
0.000	0.000	0.000	6.36146796E-02	-4.53959877E-01	-8.34545363E-01
0.000	0.000	0.000	-2.23398960E-01	-6.23334516E-03	-6.18568511E+00
0.000	0.000	0.000	1.21957733E-12	1.28294019E-11	8.34545363E-01
0.000	0.000	0.000	2.64012549E-01	9.20694319E-03	-6.18568511E+00
0.000	0.000	0.000	-6.36146796E-02	-4.53959877E-01	8.34545363E-01
0.000	0.000	0.000	-1.83451684E-01	5.80979214E-03	-4.41928983E+00
0.000	0.000	0.000	-1.90461777E-12	9.66640881E-12	-6.06429426E-01
0.000	0.000	0.000	2.08174451E-01	-6.39862228E-03	-4.41928983E+00
0.000	0.000	0.000	5.04432885E-02	-3.32144096E-01	-6.06429426E-01
0.000	0.000	0.000	-1.83451684E-01	-5.80979208E-03	-4.41928983E+00
0.000	0.000	0.000	1.17741424E-12	9.67623296E-12	6.06429426E-01
0.000	0.000	0.000	2.08174451E-01	6.39862219E-03	-4.41928983E+00
0.000	0.000	0.000	-5.04432885E-02	-3.32144096E-01	6.06429426E-01
0.000	0.000	0.000	-1.43685929E-01	5.50705251E-03	-2.99346962E+00
0.000	0.000	0.000	-1.69344755E-12	6.77515863E-12	-4.21350934E-01
0.000	0.000	0.000	1.73438045E-01	-4.60871715E-03	-2.99346962E+00
0.000	0.000	0.000	4.20959576E-02	-2.33002462E-01	-4.21350934E-01
0.000	0.000	0.000	-1.43665929E-01	-5.50705246E-03	-2.99346962E+00
0.000	0.000	0.000	1.05663865E-12	6.75988664E-12	4.21350934E-01
0.000	0.000	0.000	1.73438045E-01	4.60871709E-03	-2.99346962E+00
0.000	0.000	0.000	-4.20959576E-02	-2.33002462E-01	4.21350934E-01
0.000	0.000	0.000	-1.03979761E-01	5.57142769E-03	-1.86545964E+00
0.000	0.000	0.000	-1.36530271E-12	4.29229075E-12	-2.69781552E-01
0.000	0.000	0.000	1.38741259E-01	-4.65662132E-03	-1.86545964E+00
0.000	0.000	0.000	3.36887337E-02	-1.51147560E-01	-2.69781552E-01
0.000	0.000	0.000	-1.03979761E-01	-5.57142766E-03	-1.86545964E+00
0.000	0.000	0.000	8.60205919E-13	4.27118049E-12	2.69781552E-01
0.000	0.000	0.000	1.38741259E-01	4.65662128E-03	-1.86545964E+00
0.000	0.000	0.000	-3.36887337E-02	-1.51147560E-01	2.69781552E-01
0.000	0.000	0.000	-6.47058437E-02	3.77804463E-03	-1.03420782E+00
0.000	0.000	0.000	-9.39283214E-13	2.41110289E-12	-1.51882257E-01
0.000	0.000	0.000	1.04039052E-01	-4.84703847E-03	-1.03420782E+00
0.000	0.000	0.000	2.52609136E-02	-6.65855538E-02	-1.51882257E-01
0.000	0.000	0.000	-6.47058437E-02	-3.77804461E-03	-1.03420782E+00
0.000	0.000	0.000	5.98804590E-13	2.39403622E-12	1.51882257E-01
0.000	0.000	0.000	1.04039052E-01	4.84703844E-03	-1.03420782E+00
0.000	0.000	0.000	-2.52609136E-02	-6.65855538E-02	1.51882257E-01
0.000	0.000	0.000	-4.28604366E-02	2.81495925E-03	-4.64014155E-01
0.000	0.000	0.000	-6.57357134E-13	1.10248628E-12	-6.76189459E-02
0.000	0.000	0.000	6.93315034E-02	-4.89150124E-03	-4.64014155E-01
0.000	0.000	0.000	1.68707419E-02	-4.07364932E-02	-6.76189459E-02
0.000	0.000	0.000	-4.28604366E-02	-2.81495924E-03	-4.64014155E-01
0.000	0.000	0.000	4.22166595E-13	1.08819324E-12	6.76189459E-02
0.000	0.000	0.000	6.93315034E-02	4.89150123E-03	-4.64014155E-01
0.000	0.000	0.000	-1.68707419E-02	-4.07364932E-02	6.76189459E-02
0.000	0.000	0.000	-2.11374625E-02	3.18942282E-03	-1.19815138E-01
0.000	0.000	0.000	-3.39524029E-13	2.86680956E-13	-1.69387310E-02
0.000	0.000	0.000	3.46101108E-02	-5.45550175E-03	-1.19815138E-01
0.000	0.000	0.000	8.46936551E-03	-1.18567436E-02	-1.69387310E-02
0.000	0.000	0.000	-2.11374625E-02	-3.18942282E-03	-1.19815138E-01
0.000	0.000	0.000	2.19619969E-13	2.69029845E-13	1.69387310E-02

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JOINT      -X        -Y        -Z       FORCE-X      FORCE-Y      FORCE-Z       DISPL-X            DISPL-Y            DISPL-Z

  36     96.000    12.000     6.000      0.000        0.000        0.000     3.46101108E-02     5.45550175E-03    -1.19815138E-01
  37    108.000     0.000     3.000      0.000        0.000        0.000    -8.46936551E-03    -1.18567436E-02     1.69387310E-02
  38    108.000     0.000     6.000      0.000        0.000        0.000     0.                 0.                 0.
  39    108.000    12.000     9.000      0.000        0.000        0.000     0.                 0.                 0.
  40    108.000    12.000     6.000      0.000        0.000        0.000     0.                 0.                 0.
                                         0.000        0.000        0.000     0.                 0.                 0.
                                         0.000        0.000        0.000     0.                 0.                 0.
                                         0.000        0.000        0.000     0.                 0.                 0.
                                         0.000        0.000        0.000     0.                 0.                 0.
                                         0.000        0.000        0.000     0.                 0.                 0.
                                         0.000        0.000        0.000     0.                 0.                 0.

 NUMBER OF LAMINAE IN COMPOSITE ELEMENTS
(  1)   3   3   3   3 (  2)   3   3   3   3 (  3)   6   3   3   3 (  4)   4   3   3   3 (  5)  10   3   3   3
(  6)   7   3   3   3 (  7)   8   3   3   3 (  8)  10   3   3   3 (  9)  11   3   3   3 ( 10)  12   3   3   3
( 11)  13   3   3   3 ( 12)  15   3   3   3 ( 13)  28   3   3   3 ( 14)  17   3   3   3 ( 15)  33   3   3   3
( 16)  20   3   3   3 ( 17)  38   3   3   3 ( 18)  23   3   3   3 (

 TOTAL THICKNESS OF ELEMENTS

             1          2          3          4          5          6          7          8          9          0

  0      .416E-01   .416E-01   .578E-01   .484E-01   .795E-01   .639E-01   .718E-01   .783E-01   .845E-01   .926E-01
  1      .977E-01   .107E+00   .174E+00   .119E+00   .198E+00   .133E+00   .225E+00   .147E+00   .833E-01   .833E-01   10
  2      .833E-01   .833E-01   .833E-01   .833E-01   .833E-01   .833E-01   .833E-01   .833E-01   .833E-01   .833E-01   20
  3      .833E-01   .833E-01   .833E-01   .833E-01   .833E-01   .833E-01   .100E-01   .100E-01   .100E-01   .100E-01   30
  4      .100E-01   .100E-01   .100E-01   .100E-01   .100E-01   .100E-01   .100E-01   .100E-01   .100E-01   .100E-01   40
  5      .100E-01   .100E-01   .100E-01   .100E-01 0.                                                                 50

TIME USED IN SECONDS =    90.0130

 RELATIVE AREAS OF MEMBERS
  .184813   .184813   .256353   .215195   .353116   .283987   .319017   .347977   .375245   .411409
  .433826   .475608   .773939   .527754   .879102   .592289  1.000000   .652953   .370218   .370218
  .370218   .370218   .370218   .370218   .370218   .370218   .370218   .370218   .370218   .370218
  .370218   .370218   .370218   .370218   .370218   .370218   .044426   .044426   .044426   .044426
  .044426   .044426   .044426   .044426   .044426   .044426   .044426   .044426   .044426   .044426
  .044426   .044426   .044426   .044426

  .046203   .046203   .113344   .076586   .214506   .145378   .180408   .209368   .236635   .272799
  .295216   .336999   .635330   .369144   .740461   .453680   .861347   .514343

  .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203
  .046203   .046203   .046203   .046203   .046214   .046203   .046218   .046203

  .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203
  .046203   .046203   .046203   .046203   .046214   .046203   .046218   .046203

  .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203   .046203
  .046203   .046203   .046203   .046203   .046214   .046203   .046218   .046203

WEIGHT-SKIN=  5.519061E+01    WEIGHT-S-PANELS=  1.512002E+01    WEIGHT-POSTS=  5.400006E-02    TOTAL-WEIGHT=  7.036463E+01
    ELE SKIN=   6         ABASE=      .2251E+00         ELE STRUCT=   20          CBASE=      .2251E+00
STRUCTURE NO=   1           NO OF LOADS=    2           CYCLE NO=   17         EQ CYCLE NO=    6          NSTBLTY=    1

TIME USED IN SECONDS =    95.0810

 RELATIVE AREAS OF MEMBERS
  .186630   .395344   .233665   .555125   .320003   .680494   .291161   .722222   .338721   .799255
  .388271   .867606   .675952   .868799   .764875   .928119   .867126  1.000000   .313144   .313144
  .313144   .313144   .313144   .313144   .313144   .313144   .313144   .313144   .313144   .313144
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 .313144   .313144   .313144   .313144   .313144   .313144   .044412   .044412   .044412   .044412
 .044412   .044412   .044412   .044412   .044412   .044412   .044412   .044412   .844412   .044412
 .044412   .044412   .044412   .044412

 .046189   .046189   .103100   .064779   .181438   .122966   .152595   .177091   .200155   .230744
 .249705   .255046   .537386   .329153   .626310   .383739   .728563   .435053

 .046189   .046189   .046189   .046189   .046189   .046189   .046189   .046189   .046189   .046189
 .046189   .046189   .046189   .046189   .046189   .046189   .046189   .046189

 .047127   .151484   .046189   .222078   .046189   .255670   .046189   .249471   .046189   .261161
 .046189   .268186   .046189   .246729   .046189   .249095   .046189   .259380

 .047127   .151484   .046189   .222078   .046189   .255670   .046189   .249471   .046189   .261161
 .046189   .268186   .046189   .246729   .046189   .249095   .046189   .259380

WEIGHT-SKIN=  1.123766E+02    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  6.382194E-02    TOTAL-WEIGHT=  1.275604E+02
     ELE SKIN=   17      ABASE=      .2643E+00       ELE STRUCT=   19        CBASE=       .2661E+00
STRUCTURE NO=    1         NO OF LOADS=    2          CYCLE NO=   17       EQ CYCLE NO=    6         NSTBLTY=    2

TIME USED IN SECONDS =  100.1490

RELATIVE AREAS OF MEMBERS
 .184867   .411463   .223913   .592172   .300224   .714882   .273164   .767559   .317784   .841249
 .364271   .904121   .634171   .855565   .717598   .906211   .813528  1.000000   .315252   .315252
 .315252   .315252   .315252   .315252   .315252   .315252   .315252   .315252   .315252   .315252
 .315252   .315252   .315252   .315252   .315252   .315252   .041667   .041667   .041667   .041667
 .041667   .041667   .041667   .041667   .041667   .041667   .041667   .041667   .041667   .041667
 .041667   .041667   .041667   .041667

 .043334   .043334   .393912   .060775   .170223   .115365   .143163   .166145   .187783   .216482
 .234270   .267427   .504170   .308808   .587597   .360020   .683527   .408160

 .043334   .043334   .043334   .043334   .043334   .043334   .043334   .043334   .043334   .043334
 .043334   .043334   .043334   .043334   .043334   .043334   .043334   .043334

 .049100   .162398   .043334   .244032   .043334   .278092   .043334   .279040   .043334   .230717
 .043334   .296680   .043334   .251712   .043334   .251429   .043334   .274253

 .049100   .162398   .043334   .244032   .043334   .278092   .043334   .279040   .043334   .230717
 .043334   .296680   .043334   .251712   .043334   .251429   .043334   .274253

WEIGHT-SKIN=  1.225107E+02    WEIGHT-S-PANELS=  1.611615E+01    WEIGHT-POSTS=  6.339521E-02    TOTAL-WEIGHT=  1.386903E+02
     ELE SKIN=   17      ABASE=      .2818E+00       ELE STRUCT=   28        CBASE=       .2643E+00
STRUCTURE NO=    1         NO OF LOADS=    2          CYCLE NO=   17       EQ CYCLE NO=    6         NSTBLTY=    3

TIME USED IN SECONDS =  105.1730

RELATIVE AREAS OF MEMBERS
 .182827   .415638   .213193   .601667   .293894   .723680   .267405   .780066   .311085   .852602
 .356592   .913736   .620301   .650642   .702469   .839123   .796377  1.000000   .308606   .308606
 .308606   .308606   .308606   .308606   .308606   .308606   .308606   .308606   .308606   .308606
 .308606   .308606   .308606   .308606   .308606   .308606   .040789   .040789   .040789   .040789
 .040789   .040789   .040789   .040789   .040789   .040789   .040789   .040789   .040789   .040789
 .040789   .040789   .040789   .040789

 .042420   .042420   .091932   .059494   .166634   .112933   .140145   .162642   .183824   .211918
 .229331   .261789   .493540   .302297   .575209   .352430   .669117   .399555

 .042420   .042420   .042420   .042420   .042420   .042420   .042420   .042420   .042420   .042420
 .042420   .042420   .042420   .042420   .042420   .042420   .042420   .042420

 .048994   .165399   .042420   .249876   .042420   .284164   .042420   .287502   .042420   .239132
 .042420   .304763   .042420   .252962   .042420   .252136   .042420   .279012

 .048994   .165399   .042420   .249876   .042420   .284164   .042420   .287502   .042420   .239132
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 .042421    .304763    .042420    .252962    .042420    .252136    .042420    .279012


WEIGHT-SKIN=  1.260007E+02    WEIGHT-S-PANELS=  1.611615E+01    WEIGHT-POSTS=  6.339521E-02    TOTAL-WEIGHT=  1.421803E+02
     ELE SKIN=    17     ABASE=      .2678E+00         ELE STRUCT=   27         CBASE=       .2700E+00
STRUCTURE NO=     1          NO OF LOADS=    2             CYCLE NO=   17          EQ CYCLE NO=     6            NSTBLTY=    4

TIME USED IN SECONDS =  110.1960

 RELATIVE AREAS OF MEMBERS
 .181997     .416779     .217926     .604242     .292196     .726068     .265860     .783730     .309287     .855868
 .354531     .916427     .617213     .848798     .698410     .896660     .791775    1.000000     .306822     .306822
 .306822     .306822     .306822     .306822     .306822     .306822     .306822     .306822     .306822     .306822
 .306822     .306822     .306822     .306822     .306822     .306822     .040553     .040553     .040553     .040553
 .040553     .040553     .040553     .040553     .040553     .040553     .040553     .040553     .040553     .040553
 .040553     .040553     .040553     .040553

 .042175     .042175     .091401     .059150     .165671     .112280     .139335     .161702     .182762     .210693
 .228006     .260276     .490688     .300550     .571865     .350393     .665250     .397246

 .042175     .042175     .042175     .042175     .042175     .042175     .042175     .042175     .042175     .042175
 .042175     .042175     .042175     .042175     .042175     .042175     .042175     .042175

 .048824     .166215     .042175     .251459     .042175     .285806     .042175     .289926     .042175     .301500
 .042175     .306988     .042175     .253037     .042175     .252046     .042175     .280289

 .048824     .166215     .042175     .251459     .042175     .285806     .042175     .289926     .042175     .301500
 .042175     .306988     .042175     .253037     .042175     .252046     .042175     .280289


WEIGHT-SKIN=  1.269635E+02    WEIGHT-S-PANELS=  1.611615E+01    WEIGHT-POSTS=  6.339521E-02    TOTAL-WEIGHT=  1.431491E+02
     ELE SKIN=    17     ABASE=      .2695E+00         ELE STRUCT=   33         CBASE=       .2716E+00
STRUCTURE NO=     1          NO OF LOADS=    2             CYCLE NO=   17          EQ CYCLE NO=     6            NSTBLTY=    5

TIME USED IN SECONDS =  115.1390

 RELATIVE AREAS OF MEMBERS
 .181734     .417096     .217577     .604953     .291728     .726727     .265434     .784818     .308791     .856821
 .353963     .917192     .616224     .848165     .697291     .895852     .790506    1.000000     .306331     .306331
 .306331     .306331     .306331     .306331     .306331     .306331     .306331     .306331     .306331     .306331
 .306331     .306331     .306331     .306331     .306331     .306331     .040488     .040488     .040488     .040488
 .040488     .040488     .040488     .040488     .040488     .040488     .040488     .040488     .040488     .040488
 .040488     .040488     .040488     .040488

 .042107     .042107     .091255     .059055     .165406     .112101     .139112     .161443     .182469     .210355
 .227641     .259859     .489902     .300069     .570969     .349832     .664184     .396610

 .042107     .042107     .042107     .042107     .042107     .042107     .042107     .042107     .042107     .042107
 .042107     .042107     .042107     .042107     .042107     .042107     .042107     .042107

 .048759     .166441     .042107     .251895     .042107     .286260     .042107     .290634     .042107     .302179
 .042107     .307613     .042107     .252994     .042107     .251956     .042107     .280641

 .048759     .166441     .042107     .251895     .042107     .286260     .042107     .290634     .042107     .302179
 .042107     .307613     .042107     .252994     .042107     .251956     .042107     .280641


WEIGHT-SKIN=  1.272406E+02    WEIGHT-S-PANELS=  1.611615E+01    WEIGHT-POSTS=  6.339521E-02    TOTAL-WEIGHT=  1.434202E+02
     ELE SKIN=    17     ABASE=      .2900E+00         ELE STRUCT=   20         CBASE=       .2720E+00
STRUCTURE NO=     1          NO OF LOADS=    2             CYCLE NO=   17          EQ CYCLE NO=     6            NSTBLTY=    6

TIME USED IN SECONDS =  120.2430

 RELATIVE AREAS OF MEMBERS
 .181656     .417184     .217480     .605149     .291598     .726911     .265316     .785141     .308654     .857100
 .353805     .917410     .615350     .847959     .696980     .895597     .790154    1.000000     .306194     .306194
 .306194     .306194     .306194     .306194     .306194     .306194     .306194     .306194     .306194     .306194
 .306194     .306194     .306194     .306194     .306194     .306194     .040470     .040470     .040470     .040470
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 .040470    .040470    .040470    .040470    .040470    .040470    .040470    .040470    .040470    .040470
 .040470    .040470    .040470    .040470

 .042089    .042089    .091714    .059029    .165332    .112051    .139050    .161371    .182388    .210262
 .227539    .259744    .484684    .299935    .570714    .349676    .663888    .396433

 .042089    .042089    .042089    .042089    .042089    .042089    .042089    .042089    .042089    .042089
 .042089    .042089    .042089    .042089    .042089    .042089    .042089    .042089

 .048740    .166503    .042089    .252016    .042089    .286386    .042089    .290841    .042089    .302375
 .042089    .307789    .042089    .252967    .042089    .251916    .042089    .280739

 .048740    .166503    .042089    .252016    .042089    .286386    .042089    .290841    .042089    .302375
 .042089    .307789    .042089    .252967    .042089    .251916    .042089    .280739


WEIGHT-SKIN=  1.273168E+02    WEIGHT-S-PANELS=  1.611615E+01    WEIGHT-POSTS=  6.339521E-02    TOTAL-WEIGHT=  1.434963E+02
    ELE SKIN=    17      ABASE=      .2901E+00        ELE STRUCT=   28        CBASE=      .2722E+00
STRUCTURE NO=    1         NO OF LOADS=    2          CYCLE NO=   17       EQ CYCLE NO=     6         NSTBLTY=    7

TIME USED IN SECONDS =  125.3280

  RELATIVE AREAS OF MEMBERS
 .181634    .417208    .217453    .605204    .291561    .726961    .265283    .785237    .308615    .357182
 .353761    .317472    .615873    .647994    .696893    .695519    .790056   1.000000    .306156    .306156
 .306156    .306156    .306156    .306156    .306156    .306156    .306156    .306156    .306156    .306156
 .306156    .306156    .306156    .306156    .306156    .306156    .040465    .040465    .040465    .040465
 .040465    .040465    .040465    .040465    .040465    .040465    .040465    .040465    .040465    .040465
 .040465    .040465    .040465    .040465

 .042083    .042083    .091203    .059022    .165311    .112037    .139033    .161351    .182365    .210235
 .227511    .259711    .483623    .299898    .570643    .349633    .663806    .396384

 .042083    .042083    .042083    .042083    .042083    .042083    .042083    .042083    .042083    .042083
 .042083    .042083    .042083    .042083    .042083    .042083    .042083    .042083

 .048734    .166521    .042083    .252050    .042083    .286421    .042083    .290901    .042083    .302431
 .042083    .307839    .042083    .252956    .042083    .251902    .042083    .280766

 .048734    .166521    .042083    .252050    .042083    .286421    .042083    .290901    .042083    .302431
 .042083    .307839    .042083    .252956    .042083    .251902    .042083    .280766

L=   1  BASEA=  .15770E+00  L-C= 1  CRI= 2  LAR= 2  PRCNT=   .232   .232   .268   .268
L=   2  BASEA=  .85078E-01  L-C= 1  CRI= 3  LAR= 4  PRCNT=   .101   .101   .399   .399
L=   3  BASEA=  .28268E+00  L-C= 1  CRI= 2  LAR= 2  PRCNT=   .419   .194   .194   .194
L=   4  BASEA=  .16095E+00  L-C= 1  CRI= 3  LAR= 4  PRCNT=   .098   .070   .416   .416
L=   5  BASEA=  .28530E+00  L-C= 1  CRI= 2  LAR= 2  PRCNT=   .567   .144   .144   .144
L=   6  BASEA=  .18517E+00  L-C= 1  CRI= 3  LAR= 4  PRCNT=   .154   .058   .394   .394
L=   7  BASEA=  .28779E+00  L-C= 1  CRI= 2  LAR= 2  PRCNT=   .524   .159   .159   .159
L=   8  BASEA=  .23102E+00  L-C= 1  CRI= 1  LAR= 1  PRCNT=   .205   .054   .370   .370
L=   9  BASEA=  .28863E+00  L-C= 1  CRI= 2  LAR= 2  PRCNT=   .591   .136   .136   .136
L=  10  BASEA=  .23684E+00  L-C= 1  CRI= 1  LAR= 1  PRCNT=   .245   .049   .353   .353
L=  11  BASEA=  .28914E+00  L-C= 1  CRI= 2  LAR= 2  PRCNT=   .643   .119   .119   .119
L=  12  BASEA=  .24432E+00  L-C= 1  CRI= 1  LAR= 1  PRCNT=   .283   .046   .336   .336
L=  13  BASEA=  .28968E+00  L-C= 1  CRI= 2  LAR= 2  PRCNT=   .795   .068   .068   .068
L=  14  BASEA=  .26175E+00  L-C= 1  CRI= 3  LAR= 4  PRCNT=   .354   .050   .298   .298
L=  15  BASEA=  .28993E+00  L-C= 1  CRI= 2  LAR= 2  PRCNT=   .819   .060   .060   .060
L=  16  BASEA=  .27377E+00  L-C= 1  CRI= 3  LAR= 3  PRCNT=   .390   .047   .281   .281
L=  17  BASEA=  .29013E+00  L-C= 1  CRI= 2  LAR= 2  PRCNT=   .840   .053   .053   .053
L=  18  BASEA=  .23187E+00  L-C= 1  CRI= 1  LAR= 1  PRCNT=   .396   .042   .281   .281
L=  19  BASEA=  .27219E+00  L-C= 1
L=  20  BASEA=  .27219E+00  L-C= 1
L=  21  BASEA=  .27219E+00  L-C= 1
L=  22  BASEA=  .27219E+00  L-C= 1
L=  23  BASEA=  .27219E+00  L-C= 1
L=  24  BASEA=  .27219E+00  L-C= 1
L=  25  BASEA=  .27219E+00  L-C= 1
L=  26  BASEA=  .27219E+00  L-C= 1
L=  27  BASEA=  .27219E+00  L-C= 1
L=  28  BASEA=  .27219E+00  L-C= 1
L=  29  BASEA=  .27219E+00  L-C= 1
L=  30  BASEA=  .27219E+00  L-C= 1
L=  31  BASEA=  .27219E+00  L-C= 1
L=  32  BASEA=  .27219E+00  L-C= 1
L=  33  BASEA=  .27219E+00  L-C= 1
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L=   34  BASEA=   .27219E+00  L-C= 1
L=   35  BASEA=   .27219E+00  L-C= 1
L=   36  BASEA=   .27219E+00  L-C= 1
L=   37  BASEA=   .95238E-05  L-C= 1
L=   38  BASEA=   .95238E-05  L-C= 1
L=   39  BASEA=   .95238E-05  L-C= 1
L=   40  BASEA=   .95238E-05  L-C= 1
L=   41  BASEA=   .95238E-05  L-C= 1
L=   42  BASEA=   .95238E-05  L-C= 1
L=   43  BASEA=   .95238E-05  L-C= 1
L=   44  BASEA=   .95238E-05  L-C= 1
L=   45  BASEA=   .95238E-05  L-C= 1
L=   46  BASEA=   .95238E-05  L-C= 1
L=   47  BASEA=   .95238E-05  L-C= 1
L=   48  BASEA=   .95238E-05  L-C= 1
L=   49  BASEA=   .95238E-05  L-C= 1
L=   50  BASEA=   .95238E-05  L-C= 1
L=   51  BASEA=   .95238E-05  L-C= 1
L=   52  BASEA=   .95238E-05  L-C= 1
L=   53  BASEA=   .95238E-05  L-C= 1
L=   54  BASEA=   .95238E-05  L-C= 1

WEIGHT-SKIN=  1.273332E+02     WEIGHT-S-PANELS=  1.611615E+01     WEIGHT-POSTS=  6.339521E-02     TOTAL-WEIGHT=  1.435177E+02
     ELE SKIN=    17       ABASE=        .2901E+00          ELE STRUCT=    28          CBASE=          .2722E+00
STRUCTURE NO=    1              NO OF LOADS=    2           CYCLE NO=    17         EQ CYCLE NO=     6              NSTBLTY=     8
                          MINIMUM WEIGHT CYCLE=    16
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*****S T R E S S E S*****

MEMB    1  NODES     1     3     7     5  AREA .1440E+03   THICK.5270E-01   LAYER(THICK) .1221E-01 .1221E-01 .1414E-01 .1414E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.3684E+03 .3404E+05-.3270E-08 2 -.1210E+05 .2691E+04 .5537E-07 3  .4418E+04 .7715E+04 .4906E+04 4  .4418E+04 .7715E+04-.4906E+04
2 1  .3250E-10-.2586E-08-.2654E-11 2  .9715E-09-.2034E-09-.2654E-11 3 -.3366E-09-.5908E-09-.3808E-09 4 -.3019E-09-.5562E-09 .3411E-09
NODAL FORCES
1 -.4000E+04  .7130E-09 0.
2 -.1170E-08  .1588E-09 0.        -.4000E+04 -.8713E-09 0.
                                    .1773E-08 -.1513E-09 0.        .4000E+04 -.3271E+03 0.
                                                                 -.1780E-08  .1901E-09 0.        .4000E+04  .3271E+03 0.
                                                                                                  .1177E-08 -.1976E-09 0.

MEMB    2  NODES     2     4     8     6  AREA .1440E+03   THICK.1210E+00   LAYER(THICK) .1221E-01 .1221E-01 .4831E-01 .4831E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .8242E+03-.2345E+05 .1235E-08 2  .1496E+05-.1722E+04-.6990E-07 3 -.9741E+03-.3719E+04-.1897E+04 4 -.9741E+03-.3719E+04 .1897E+04
2 1 -.9875E-09 .2002E-07 .1118E+03 2 -.3091E-07 .1323E-08 .1118E+03 3  .7305E+03 .7305E+03 .8342E+03 4 -.7305E+03-.7305E+03 .8342E+03
NODAL FORCES
1  .4000E+04  .1682E-08 0.
2 -.4307E-08 -.5000E+03 0.         .4000E+04 -.2321E-08 0.
                                   -.4657E-09 -.5000E+03 0       -.4000E+04  .1183E+04 0.
                                                                  .1000E+04  .5000E+03 0.       -.4000E+04 -.1183E+04 0.
                                                                                                -.1000E+04  .5000E+03 0.

MEMB    3  NODES     5     7    11     9  AREA .1440E+03   THICK.6309E-01   LAYER(THICK) .2646E-01 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.1888E+03 .5963E+05-.3904E-08 2 -.1590E+05 .4823E+04 .7429E-07 3  .9406E+04 .1481E+05 .9790E+04 4  .9406E+04 .1481E+05-.9790E+04
2 1 -.1613E-10-.1185E-07-.2357E-09 2  .2534E-08-.9698E-09-.2357E-09 3 -.3602E-08-.4630E-08-.3842E-08 4 -.5218E-09-.1550E-08 .3241E-09
NODAL FORCES
1 -.1200E+05 -.3271E+03 0.
2 -.1303E-08  .3683E-09 0.        -.1200E+05  .3271E+03 0.
                                    .6113E-08  .2565E-09 0.        .1200E+05  .3942E+02 0.
                                                                 -.6738E-08 -.4945E-09 0.        .1200E+05 -.3942E+02 0.
                                                                                                  .1927E-08 -.1302E-09 0.

MEMB    4  NODES     6     8    12    10  AREA .1440E+03   THICK.1756E+00   LAYER(THICK) .1712E-01 .1221E-01 .7313E-01 .7313E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .1376E+04-.4609E+05 .1715E-08 2  .2657E+05-.3441E+04-.1250E-06 3 -.2799E+04-.7991E+04-.4363E+04 4 -.2799E+04-.7991E+04 .4363E+04
2 1 -.1332E-08 .2248E-07 .7437E+02 2 -.3051E-07 .1473E-08 .7437E+02 3  .4859E+03 .4859E+03 .5549E+03 4 -.4859E+03-.4859E+03 .5549E+03
NODAL FORCES
1  .1200E+05  .1183E+04 0.
2  .1000E+04 -.5000E+03 0.         .1200E+05 -.1183E+04 0.
                                   -.1000E+04 -.5000E+03 0.       -.1200E+05  .4476E+03 0.
                                                                  .2000E+04  .5000E+03 0.       -.1200E+05 -.4476E+03 0.
                                                                                                -.2000E+04  .5000E+03 0.

MEMB    5  NODES     9    11    15    13  AREA .1440E+03   THICK.8459E-01   LAYER(THICK) .4796E-01 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.2836E+03 .5072E+05-.5874E-08 2 -.1724E+05 .4885E+04 .7660E-07 3  .9235E+04 .1481E+05 .9720E+04 4  .9235E+04 .1481E+05-.9720E+04
2 1  .8790E-10 .8228E-08-.3471E-09 2 -.8680E-09 .6310E-09-.3471E-09 3 -.5576E-09 .9243E-10-.9440E-09 4  .3977E-08 .4627E-08-.4235E-08
NODAL FORCES
1 -.2000E+05  .3942E+02 0.
2 -.2647E-07  .3405E-10 0.        -.2000E+05 -.3942E+02 0.
                                    .2294E-07  .3753E-09 0.        .2000E+05  .5668E+02 0.
                                                                 -.2395E-07 -.5509E-09 0.        .2000E+05 -.5668E+02 0.
                                                                                                  .2948E-07 -.4535E-09 0.

MEMB    6  NODES    10    12    16    14  AREA .1440E+03   THICK.2109E+00   LAYER(THICK) .3250E-01 .1221E-01 .8310E-01 .8310E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .1555E+04-.5329E+05 .1380E-08 2  .3031E+05-.3987E+04-.1432E-06 3 -.3367E+04-.9341E+04-.5136E+04 4 -.3367E+04-.9341E+04 .5138E+04
2 1 -.1011E-08 .1688E-07 .6487E+02 2 -.2419E-07 .1095E-08 .6487E+02 3  .4238E+03 .4238E+03 .4840E+03 4 -.4238E+03-.4238E+03 .4840E+03
NODAL FORCES
1  .2000E+05  .4476E+03 0.
2  .2000E+04 -.5000E+03 0.         .2000E+05 -.4476E+03 0.
                                   -.2000E+04 -.5000E+03 0.       -.2000E+05 -.1220E+04 0.
                                                                  .3000E+04  .5000E+03 0.       -.2000E+05  .1220E+04 0.
                                                                                                -.3000E+04  .5000E+03 0.

MEMB    7  NODES    13    15    19    17  AREA .1440E+03   THICK.7697E-01   LAYER(THICK) .4034E-01 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.9242E+03 .1051E+06-.7219E-08 2 -.1629E+05 .4910E+04 .7503E-07 3  .9550E+04 .1506E+05 .9949E+04 4  .9550E+04 .1506E+05-.9949E+04
2 1 -.2721E-09 .3386E-07-.2253E-09 2 -.5654E-08 .1823E-08-.1575E-09 3  .2618E-08 .4629E-08 .2587E-08 4  .4676E-08 .6686E-08-.4937E-08
NODAL FORCES
1 -.2800E+05  .5668E+02 0.
2 -.7925E-07 -.2534E-10 0.        -.2800E+05 -.5668E+02 0.
                                    .5851E-07  .5017E-09 0.        .2800E+05  .2126E+02 0.
                                                                 -.5899E-07 -.3930E-09 0.        .2800E+05 -.2126E+02 0.
                                                                                                  .7973E-07 -.3334E-10 0.

MEMB    8  NODES    14    16    20    18  AREA .1440E+03   THICK.2278E+00   LAYER(THICK) .4681E-01 .1221E-01 .8440E-01 .8440E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .3411E+04-.7358E+05 .9091E-09 2  .2608E+05-.3149E+04-.1235E-06 3 -.2108E+04-.7014E+04-.3688E+04 4 -.2108E+04-.7014E+04 .3688E+04
2 1 -.1746E-08 .3485E-08 .8907E+02 2 -.1846E-07 .1779E-09 .6226E+02 3  .4067E+03 .4067E+03 .4645E+03 4 -.4067E+03-.4067E+03 .4645E+03
NODAL FORCES
1  .2800E+05 -.1220E+04 0.
2  .3000E+04 -.5000E+03 0.         .2800E+05  .1220E+04 0.
                                   -.3000E+04 -.5000E+03 0.       -.2800E+05  .2486E+03 0.
                                                                  .4000E+04  .5000E+03 0.       -.2800E+05 -.2486E+03 0.
                                                                                                -.4000E+04  .5000E+03 0.
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MEMB    9  NODES   17   19   23   21  AREA .1440E+03  THICK.8954E-01  LAYER(THICK) .5291E-01 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.8710E+03 .1053E+06-.5374E-08 2 -.1603E+05 .4324E+04 .7511E-07 3  .9657E+04 .1515E+05 .1003E+05 4  .9657E+04 .1515E+05-.1003E+05
2 1 -.5035E-09 .5771E-07-.1569E-09 2 -.8923E-08 .2697E-08-.1097E-09 3  .4534E-08 .7558E-08 .4650E-08 4  .5968E-08 .8331E-08-.6287E-08
NODAL FORCES
1 -.3600E+05  .2126E+02 0.         -.3600E+05 -.2126E+02 0.          .3600E+05 -.4986E+02 0.          .3600E+05  .4986E+02 0.
2 -.1513E-06  .5779E-10 0.          .1118E-06  .2877E-09 0.         -.1122E-06 -.3761E-09 0.          .1516E-06  .2059E-10 0.

MEMB   10  NODES   18   20   24   22  AREA .1440E+03  THICK.2437E+00  LAYER(THICK) .6099E-01 .1221E-01 .8774E-01 .8774E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .3063E+04-.7543E+05 .7615E-09 2  .2443E+05-.3274E+04-.1160E-06 3 -.2880E+04-.7746E+04-.4296E+04 4 -.2880E+04-.7746E+04 .4296E+04
2 1  .4834E-09-.1286E-07 .8463E+02 2 -.3868E-08-.6015E-09 .5915E+02 3  .3865E+03 .3865E+03 .4413E+03 4 -.3865E+03-.3865E+03 .4413E+03
NODAL FORCES
1  .3600E+05  .2486E+03 0.          .3600E+05 -.2486E+03 0.         -.3600E+05  .4951E+01 0.         -.3600E+05 -.4951E+01 0.
2  .4000E+04 -.5000E+03 0.         -.4000E+04 -.5000E+03 0.          .5000E+04  .5000E+03 0.         -.5000E+04  .5000E+03 0.

MEMB   11  NODES   21   23   27   25  AREA .1440E+03  THICK.1026E+00  LAYER(THICK) .6601E-01 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.3912E+03 .1044E+06-.3945E-08 2 -.1338E+05 .4933E+04 .6362E-07 3  .1036E+05 .1563E+05 .1051E+05 4  .1036E+05 .1563E+05-.1051E+05
2 1 -.2143E-09 .7467E-07-.2320E-09 2 -.9224E-08 .3535E-08-.1621E-09 3  .6459E-08 .1020E-07 .6384E-08 4  .8578E-08 .1232E-07-.8804E-08
NODAL FORCES
1 -.4400E+05 -.4986E+02 0.         -.4400E+05  .4986E+02 0.          .4400E+05  .7152E+03 0.          .4400E+05 -.7152E+03 0.
2 -.2381E-06  .4691E-10 0.          .1732E-06  .5151E-09 0.         -.1737E-06  .1668E-09 0.          .2367E-06 -.7238E-09 0.

MEMB   12  NODES   22   24   28   26  AREA .1440E+03  THICK.2662E+00  LAYER(THICK) .7535E-01 .1221E-01 .8931E-01 .8931E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .3153E+04-.7781E+05 .6155E-09 2  .2516E+05-.3376E+04-.1196E-06 3 -.2984E+04-.8000E+04-.4441E+04 4 -.2984E+04-.8000E+04 .4441E+04
2 1  .7066E-09-.2985E-07 .8207E+02 2 -.6079E-09-.1391E-08 .5736E+02 3  .3748E+03 .3748E+03 .4280E+03 4 -.3748E+03-.3748E+03 .4280E+03
NODAL FORCES
1  .4400E+05  .4951E+01 0.          .4400E+05 -.4951E+01 0.         -.4400E+05  .1452E+03 0.         -.4400E+05 -.1452E+03 0.
2  .5000E+04 -.5000E+03 0.         -.5000E+04 -.5000E+03 0.          .6000E+04  .5000E+03 0.         -.6000E+04  .5000E+03 0.

MEMB   13  NODES   25   27   31   29  AREA .1440E+03  THICK.1787E+00  LAYER(THICK) .1421E+00 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.6359E+03 .5810E+05-.2792E-08 2 -.1665E+05 .5991E+04 .9019E-07 3  .9489E+04 .1391E+05 .9024E+04 4  .9489E+04 .1391E+05-.9024E+04
2 1 -.5078E-09 .4344E-07-.8872E-10 2 -.1368E-07 .4398E-08-.8872E-10 3  .7291E-08 .1097E-07 .6752E-08 4  .8657E-08 .1233E-07-.8383E-08
NODAL FORCES
1 -.5200E+05  .7152E+03 0.         -.5200E+05 -.7152E+03 0.          .5200E+05 -.2831E+02 0.          .5200E+05  .2831E+02 0.
2 -.3296E-06  .6309E-09 0.          .2429E-06 -.2276E-09 0.         -.2433E-06 -.3053E-09 0.          .3300E-06 -.9802E-10 0.

MEMB   14  NODES   26   28   32   30  AREA .1440E+03  THICK.2460E+00  LAYER(THICK) .8701E-01 .1221E-01 .7339E-01 .7339E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .3221E+04-.7683E+05 .1259E-08 2  .4387E+05-.7479E+04-.2243E-06 3 -.5732E+04-.1288E+05-.7176E+04 4 -.5732E+04-.1288E+05 .7176E+04
2 1  .1575E-08-.4230E-07 .5752E+02 2  .1301E-07-.3864E-08 .5752E+02 3  .4427E+03 .4427E+03 .5289E+03 4 -.4427E+03-.4427E+03 .5289E+03
NODAL FORCES
1  .5200E+05  .1452E+03 0.          .5200E+05 -.1452E+03 0.         -.5200E+05 -.1602E+03 0.         -.5200E+05  .1602E+03 0.
2  .6000E+04 -.5000E+03 0.         -.6000E+04 -.5000E+03 0.          .7000E+04  .5000E+03 0.         -.7000E+04  .5000E+03 0.

MEMB   15  NODES   29   31   35   33  AREA .1440E+03  THICK.2022E+00  LAYER(THICK) .1656E+00 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.4694E+03 .5786E+05-.2389E-08 2 -.1508E+05 .5996E+04 .8313E-07 3  .9918E+04 .1424E+05 .9314E+04 4  .9918E+04 .1424E+05-.9314E+04
2 1 -.4363E-09 .5350E-07-.6724E-10 2 -.1396E-07 .5544E-08-.6724E-10 3  .8647E-08 .1264E-07 .7990E-08 4  .9682E-08 .1368E-07-.9226E-08
NODAL FORCES
1 -.6000E+05 -.2331E+02 0.         -.6000E+05  .2831E+02 0.          .6000E+05 -.2639E+03 0.          .6000E+05  .2639E+03 0.
2 -.4273E-06  .4390E-10 0.          .3163E-06  .2807E-09 0.         -.3167E-06 -.5079E-09 0.          .4276E-06  .1833E-09 0.

MEMB   16  NODES   30   32   36   34  AREA .1440E+03  THICK.2598E+00  LAYER(THICK) .1014E+00 .1221E-01 .7308E-01 .7308E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .3519E+04-.7920E+05 .1435E-08 2  .4705E+05-.7672E+04-.2397E-06 3 -.5338E+04-.1281E+05-.6999E+04 4 -.5338E+04-.1281E+05 .6999E+04
2 1  .2551E-08-.5513E-07 .5717E+02 2  .2440E-07-.5033E-08 .5717E+02 3  .4401E+03 .4401E+03 .5257E+03 4 -.4401E+03-.4401E+03 .5257E+03
NODAL FORCES
1  .6000E+05 -.1602E+03 0.          .6000E+05  .1602E+03 0.         -.6000E+05  .1653E+04 0.         -.6000E+05 -.1653E+04 0.
2  .7000E+04 -.5000E+03 0.         -.7000E+04 -.5000E+03 0.          .8000E+04  .5000E+03 0.         -.8000E+04  .5000E+03 0.

MEMB   17  NODES   33   35   39   37  AREA .1440E+03  THICK.2292E+00  LAYER(THICK) .1926E+00 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .3356E+03 .5647E+05-.1218E-08 2 -.7430E+04 .6000E+04 .4801E-07 3  .1195E+05 .1574E+05 .1066E+05 4  .1195E+05 .1574E+05-.1068E+05
2 1  .3573E-09 .5598E-07-.6299E-10 2 -.7136E-08 .5952E-08-.6299E-10 3  .1143E-07 .1517E-07 .1005E-07 4  .1240E-07 .1614E-07-.1121E-07
NODAL FORCES
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1 -.6800E+05 -.2639E+03 0.        -.6800E+05  .2639E+03 0.        .6600E+05  .2326E+04 0.        .6800E+05 -.2926E+04 0.
2 -.5265E-06 -.1893E-09 0.         .3917E-06  .5138E-09 0.       -.3920E-06  .2759E-08 0.        .5269E-06 -.3083E-08 0.

MEMB   18  NODES   34   36   40   38  AREA .1440E+03  THICK.2901E+00  LAYER(THICK) .1150E+00 .1221E-01 .8146E-01 .3146E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .1158E+04-.7385E+05 .4463E-09 2  .2438E+05-.7549E+04-.1328E-06 3 -.1106E+05-.1687E+05-.1077E+05 4 -.1106E+05-.1687E+05 .1077E+05
2 1  .9329E-09-.5873E-07 .5127E+02 2  .1115E-07-.5738E-08 .5127E+02 3  .3947E+03 .3947E+03 .4715E+03 4 -.3947E+03-.3947E+03 .4715E+03
NODAL FORCES
1  .6600E+05  .1653E+04 0.         .6800E+05 -.1653E+04 0.       -.6800E+05 -.1479E+05 0.       -.6600E+05  .1473E+05 0.
2  .8000E+04 -.5000E+03 0.        -.8000E+04 -.5000E+03 0.        .9000E+04  .5000E+03 0.       -.9000E+04  .5000E+03 0.
MEMB   19  NODES    1    2    6    5  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.1510E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2  .6519E-08 0.          -.1630E-08 -.6519E-08 0.        -.1630E-08 -.6519E-08 0.         .1630E-08  .6519E-08 0.         .1630E-08
MEMB   20  NODES    3    4    8    7  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .5259E-08
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2 -.5588E-08 0.           .1397E-08  .5588E-08 0.         .1397E-08  .5588E-06 0.        -.1397E-08 -.5588E-08 0.        -.1397E-08
MEMB   21  NODES    5    6   10    9  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.3737E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2  .2049E-07 0.          -.5122E-08 -.2049E-07 0.        -.5122E-08 -.2049E-07 0.         .5122E-08  .2049E-07 0.         .5122E-08
MEMB   22  NODES    7    8   12   11  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .3338E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2 -.1770E-07 0.           .4424E-08  .1770E-07 0.         .4424E-08  .1770E-07 0.        -.4424E-08 -.1770E-07 0.        -.4424E-08
MEMB   23  NODES    9   10   14   13  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.4227E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2  .2282E-07 0.          -.5704E-08 -.2282E-07 0.        -.5704E-08 -.2282E-07 0.         .5704E-08  .2282E-07 0.         .5704E-08
MEMB   24  NODES   11   12   16   15  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .4438E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2 -.2654E-07 0.           .6636E-08  .2654E-07 0.         .6636E-03  .2654E-07 0.        -.6636E-08 -.2654E-07 0.        -.6636E-08
MEMB   25  NODES   13   14   18   17  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.6404E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2  .3446E-07 0.          -.8615E-08 -.3446E-07 0.        -.8615E-08 -.3446E-07 0.         .8615E-08  .3446E-07 0.         .8615E-08
MEMB   26  NODES   15   16   20   19  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .5123E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2 -.3073E-07 0.           .7683E-08  .3073E-07 0.         .7683E-08  .3073E-07 0.        -.7683E-08 -.3073E-07 0.        -.7683E-08
MEMB   27  NODES   17   18   22   21  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.7594E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2  .4005E-07 0.          -.1001E-07 -.4005E-07 0.        -.1001E-07 -.4005E-07 0.         .1001E-07  .4005E-07 0.         .1001E-07
MEMB   28  NODES   19   20   24   23  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .6053E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2 -.3329E-07 0.           .8324E-08  .3329E-07 0.         .8324E-08  .3329E-07 0.        -.8324E-08 -.3329E-07 0.        -.8324E-08
MEMB   29  NODES   21   22   26   25  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.8690E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2  .4610E-07 0.          -.1153E-07 -.4610E-07 0.        -.1153E-07 -.4610E-07 0.         .1153E-07  .4610E-07 0.         .1153E-07
MEMB   30  NODES   23   24   28   27  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .6664E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.         .1000E+04  .4000E+04 0.         .1000E+04
2 -.3679E-07 0.           .9197E-08  .3679E-07 0.         .9197E-08  .3679E-07 0.        -.9197E-08 -.3679E-07 0.        -.9197E-08
MEMB   31  NODES   25   26   30   29  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.9013E-07
        NODAL FORCES
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1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2  .4773E-07 0.        -.1193E-07 -.4773E-07 0.        -.1193E-07 -.4773E-07 0.        .1193E-07  .4773E-07 0.        .1193E-07
MEMB   32  NODES   27   28   32   31  AREA .3600E+02  THICK .8832E-01
STRESSES
1 -.7506E+04 2  .6948E-07
       NODAL FORCES
1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2 -.3690E-07 0.         .9226E-08  .3690E-07 0.         .9226E-08  .3690E-07 0.       -.9226E-08 -.3690E-07 0.       -.9226E-08
MEMB   33  NODES   29   30   34   33  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.9216E-07
       NODAL FORCES
1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2  .4920E-07 0.        -.1230E-07 -.4920E-07 0.        -.1230E-07 -.4920E-07 0.        .1230E-07  .4920E-07 0.        .1230E-07
MEMB   34  NODES   31   32   36   35  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .7002E-07
       NODAL FORCES
1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2 -.3747E-07 0.         .9368E-08  .3747E-07 0.         .9368E-08  .3747E-07 0.       -.9368E-08 -.3747E-07 0.       -.9368E-08
MEMB   35  NODES   33   34   38   37  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.9284E-07
       NODAL FORCES
1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2  .4951E-07 0.        -.1238E-07 -.4951E-07 0.        -.1238E-07 -.4951E-07 0.        .1238E-07  .4951E-07 0.        .1238E-07
MEMB   36  NODES   35   36   40   39  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .7037E-07
       NODAL FORCES
1  .4000E+04 0.        -.1000E+04 -.4000E+04 0.        -.1000E+04 -.4000E+04 0.        .1000E+04  .4000E+04 0.        .1000E+04
2 -.3753E-07 0.         .9382E-08  .3753E-07 0.         .9382E-08  .3753E-07 0.       -.9382E-08 -.3753E-07 0.       -.9382E-08
MEMB   37  NODES    1    2  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .7958E-06 2  .1243E-06
NODAL FORCES
1 0.        0.         .9313E-08 0.        0.        -.9313E-08
2 0.        0.         .1630E-08 0.        0.        -.1630E-08
MEMB   38  NODES    3    4  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .3948E-06 2 -.1741E-06
NODAL FORCES
1 0.        0.         .1304E-07 0.        0.        -.1304E-07
2 0.        0.        -.2035E-08 0.        0.         .2095E-08
MEMB   39  NODES    5    6  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .3979E-06 2  .1113E-06
NODAL FORCES
1 0.        0.         .3725E-08 0.        0.        -.3725E-08
2 0.        0.         .1164E-08 0.        0.        -.1164E-08
MEMB   40  NODES    7    8  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .5969E-06 2 -.8704E-07
NODAL FORCES
1 0.        0.         .7451E-08 0.        0.        -.7451E-08
2 0.        0.        -.9313E-09 0.        0.         .9313E-09
MEMB   41  NODES    9   10  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .3979E-06 2  .2487E-07
NODAL FORCES
1 0.        0.         .4657E-08 0.        0.        -.4657E-08
2 0.        0.         .2328E-09 0.        0.        -.2328E-09
MEMB   42  NODES   11   12  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .3979E-06 2 -.7461E-07
NODAL FORCES
1 0.        0.         .4657E-08 0.        0.        -.4657E-08
2 0.        0.        -.9313E-09 0.        0.         .9313E-09
MEMB   43  NODES   13   14  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .2487E-06 2  .2487E-07
NODAL FORCES
1 0.        0.         .2794E-08 0.        0.        -.2794E-08
2 0.        0.         .3492E-09 0.        0.        -.3492E-09
MEMB   44  NODES   15   16  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .2984E-06 2 -.2487E-07
NODAL FORCES
1 0.        0.         .3725E-08 0.        0.        -.3725E-08
2 0.        0.        -.3492E-09 0.        0.         .3492E-09
MEMB   45  NODES   17   18  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .4974E-07 2  .3109E-07
NODAL FORCES
1 0.        0.         .4657E-09 0.        0.        -.4657E-09
2 0.        0.         .3492E-09 0.        0.        -.3492E-09
MEMB   46  NODES   19   20  LENGTH .3000E+01  AREA .1174E-01
STRESSES
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1  .1492E-06 2 -.2487E-07
NODAL FORCES
1 0.          0.          .1397E-08 0.          0.          -.1397E-08
2 0.          0.         -.2910E-09 0.          0.           .2910E-09
MEMB   47  NODES    21    22  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .7461E-07 2  .1865E-07
NODAL FORCES
1 0.          0.          .9313E-09 0.          0.          -.9313E-09
2 0.          0.          .2328E-09 0.          0.          -.2328E-09
MEMB   48  NODES    23    24  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .4974E-07 2 -.2798E-07
NODAL FORCES
1 0.          0.          .4657E-09 0.          0.          -.4657E-09
2 0.          0.         -.2910E-09 0.          0.           .2910E-09
MEMB   49  NODES    25    26  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .7461E-07 2  .6217E-08
NODAL FORCES
1 0.          0.          .6985E-09 0.          0.          -.6985E-09
2 0.          0.          .5821E-10 0.          0.          -.5821E-10
MEMB   50  NODES    27    28  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .6217E-07 2 -.1554E-07
NODAL FORCES
1 0.          0.          .9313E-09 0.          0.          -.9313E-09
2 0.          0.         -.1746E-09 0.          0.           .1746E-09
MEMB   51  NODES    29    30  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .1865E-07 2  .5440E-08
NODAL FORCES
1 0.          0.          .2328E-09 0.          0.          -.2328E-09
2 0.          0.          .5821E-10 0.          0.          -.5821E-10
MEMB   52  NODES    31    32  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .3109E-07 2 -.7772E-08
NODAL FORCES
1 0.          0.          .3492E-09 0.          0.          -.3492E-09
2 0.          0.         -.8731E-10 0.          0.           .8731E-10
MEMB   53  NODES    33    34  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .1088E-07 2  .9714E-09
NODAL FORCES
1 0.          0.          .1455E-09 0.          0.          -.1455E-09
2 0.          0.          .1455E-10 0.          0.          -.1455E-10
MEMB   54  NODES    35    36  LENGTH .3000E+01  AREA .1174E-01
STPESSES
1  .9326E-08 2 -.3886E-09
NODAL FORCES
1 0.          0.          .1164E-09 0.          0.          -.1164E-09
2 0.          0.         -.3638E-11 0.          0.           .3638E-11
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*****DISPLACEMENTS*****

JOINT	-X	-Y	-Z	FORCE-X	FORCE-Y	FORCE-Z	DISPL-X	DISPL-Y	DISPL-Z
1	0.000	0.000	9.000	0.000	0.000	-1000.000	-2.83288614E-01	3.35488671E-03	-9.51717853E+00
				0.000	0.000	0.000	-1.85078321E-12	2.00367444E-11	-1.14750127E+00
2	0.000	0.000	6.000	0.000	0.000	-1000.000	2.52938380E-01	-3.09721891E-03	-9.51717853E+00
				0.000	-500.000	0.000	6.06153544E-02	-5.83827167E-01	-1.14750127E+00
3	0.000	12.000	9.000	0.000	0.000	-1000.000	-2.83288614E-01	-3.35488665E-03	-9.51717853E+00
				0.000	0.000	0.000	1.61176073E-12	2.00357267E-11	1.14750127E+00
4	0.000	12.000	6.000	0.000	0.000	-1000.000	2.52938380E-01	3.09721887E-03	-9.51717853E+00
				0.000	-500.000	0.000	-6.06153544E-02	-5.83827167E-01	1.14750127E+00
5	12.000	0.000	9.000	0.000	0.000	0.000	-2.61139826E-01	4.93120370E-03	-7.43946051E+00
				0.000	0.000	0.000	-1.83825240E-12	1.65866845E-11	-9.11450521E-01
6	12.000	0.000	6.000	0.000	0.000	0.000	2.37589322E-01	-6.89004125E-03	-7.43946051E+00
				0.000	0.000	0.000	5.74100190E-02	-4.63737642E-01	-9.11450521E-01
7	12.000	12.000	9.000	0.000	0.000	0.000	-2.61139826E-01	-4.93120366E-03	-7.43946051E+00
				0.000	0.000	0.000	1.59586324E-12	1.65890269E-11	9.11450521E-01
8	12.000	12.000	6.000	0.000	0.000	0.000	2.37589322E-01	6.89004121E-03	-7.43946051E+00
				0.000	0.000	0.000	-5.74100190E-02	-4.63737642E-01	9.11450521E-01
9	24.000	0.000	9.000	0.000	0.000	0.000	-2.22375779E-01	6.16862191E-03	-5.57452521E+00
				0.000	0.000	0.000	-1.82183196E-12	1.31728677E-11	-6.95965478E-01
10	24.000	0.000	6.000	0.000	0.000	0.000	2.07459858E-01	-1.09116515E-02	-5.57452521E+00
				0.000	0.000	0.000	5.03325023E-02	-3.54622120E-01	-6.95965478E-01
11	24.000	12.000	9.000	0.000	0.000	0.000	-2.22375779E-01	-6.16862187E-03	-5.57452521E+00
				0.000	0.000	0.000	1.56406826E-12	1.31741262E-11	6.95965478E-01
12	24.000	12.000	6.000	0.000	0.000	0.000	2.07459856E-01	1.09116515E-02	-5.57452521E+00
				0.000	0.000	0.000	-5.03325023E-02	-3.54622120E-01	6.95965478E-01
13	36.000	0.000	9.000	0.000	0.000	0.000	-1.82931333E-01	5.80904299E-03	-3.99592901E+00
				0.000	0.000	0.000	-1.71854881E-12	9.88045228E-12	-5.11431952E-01
14	36.000	0.000	6.000	0.000	0.000	0.000	1.72628262E-01	-9.40146233E-03	-3.99592901E+00
				0.000	0.000	0.000	4.19342607E-02	-2.61157822E-01	-5.11431952E-01
15	36.000	12.000	9.000	0.000	0.000	0.000	-1.82931333E-01	-5.80904296E-03	-3.99592901E+00
				0.000	0.000	0.000	1.47143482E-12	9.87784315E-12	5.11431952E-01
16	36.000	12.000	6.000	0.000	0.000	0.000	1.72628262E-01	9.40146230E-03	-3.99592901E+00
				0.000	0.000	0.000	-4.19342607E-02	-2.61157822E-01	5.11431952E-01
17	48.000	0.000	9.000	0.000	0.000	0.000	-1.43450517E-01	5.55659217E-03	-2.70056033E+00
				0.000	0.000	0.000	-1.51739086E-12	6.87547992E-12	-3.56827583E-01
18	48.000	0.000	6.000	0.000	0.000	0.000	1.44771362E-01	-8.03339887E-03	-2.70056033E+00
				0.000	0.000	0.000	3.53679241E-02	-1.82706298E-01	-3.56827583E-01
19	48.000	12.000	9.000	0.000	0.000	0.000	-1.43450517E-01	-5.55659215E-03	-2.70056033E+00
				0.000	0.000	0.000	1.29946680E-12	6.87016067E-12	3.56827583E-01
20	48.000	12.000	6.000	0.000	0.000	0.000	1.44771362E-01	8.03339885E-03	-2.70056033E+00
				0.000	0.000	0.000	-3.53679241E-02	-1.82706298E-01	3.56827583E-01
21	60.000	0.000	9.000	0.000	0.000	0.000	-1.03905546E-01	5.64084017E-03	-1.67600700E+00
				0.000	0.000	0.000	-1.21699555E-12	4.33622060E-12	-2.29102794E-01
22	60.000	0.000	6.000	0.000	0.000	0.000	1.16246374E-01	-8.35163309E-03	-1.67600700E+00
				0.000	0.000	0.000	2.84944704E-02	-1.17751843E-01	-2.29102794E-01
23	60.000	12.000	9.000	0.000	0.000	0.000	-1.03905546E-01	-5.64084015E-03	-1.67600700E+00
				0.000	0.000	0.000	1.04243193E-12	4.32908476E-12	2.29102794E-01
24	60.000	12.000	6.000	0.000	0.000	0.000	1.16246374E-01	8.35163307E-03	-1.67600700E+00
				0.000	0.000	0.000	-2.84944704E-02	-1.17751843E-01	2.29102794E-01
25	72.000	0.000	9.000	0.000	0.000	0.000	-6.47235220E-02	3.84401772E-03	-9.24808642E-01
				0.000	0.000	0.000	-8.35004920E-13	2.42719582E-12	-1.29311590E-01
26	72.000	0.000	6.000	0.000	0.000	0.000	8.68208674E-02	-8.52433623E-03	-9.24808642E-01
				0.000	0.000	0.000	2.14011313E-02	-6.67972184E-02	-1.29311590E-01
27	72.000	12.000	9.000	0.000	0.000	0.000	-6.47235220E-02	-3.84401771E-03	-9.24808642E-01
				0.000	0.000	0.000	7.16476100E-13	2.42121420E-12	1.29311590E-01
28	72.000	12.000	6.000	0.000	0.000	0.000	8.68208674E-02	8.52433623E-03	-9.24808642E-01
				0.000	0.000	0.000	-2.14011313E-02	-6.67972184E-02	1.29311590E-01
29	84.000	0.000	9.000	0.000	0.000	0.000	-4.28850074E-02	2.86827211E-03	-4.12630579E-01
				0.000	0.000	0.000	-5.83551608E-13	1.10735708E-12	-5.77161974E-02
30	84.000	0.000	6.000	0.000	0.000	0.000	5.77567680E-02	-8.51137088E-03	-4.12630579E-01
				0.000	0.000	0.000	1.43965652E-02	-3.02573738E-02	-5.77161974E-02
31	84.000	12.000	9.000	0.000	0.000	0.000	-4.28850074E-02	-2.86827211E-03	-4.12630579E-01
				0.000	0.000	0.000	5.01430089E-13	1.10230069E-12	5.77161974E-02
32	84.000	12.000	6.000	0.000	0.000	0.000	5.77567680E-02	8.51137087E-03	-4.12630579E-01
				0.000	0.000	0.000	-1.43965652E-02	-3.02573738E-02	5.77161974E-02
33	96.000	0.000	9.000	0.000	0.000	0.000	-2.11509347E-02	3.25408727E-03	-1.05673514E-01
				0.000	0.000	0.000	-3.01291691E-13	2.84282516E-13	-1.44615335E-02
34	96.000	0.000	6.000	0.000	0.000	0.000	2.77829557E-02	-9.73093159E-03	-1.05673514E-01
				0.000	0.000	0.000	7.23076674E-03	-7.89237553E-03	-1.44615335E-02
35	96.000	12.000	9.000	0.000	0.000	0.000	-2.11509347E-02	-3.25408727E-03	-1.05673514E-01
				0.000	0.000	0.000	2.59365991E-13	2.78000637E-13	1.44615335E-02

```
JOINT        -X         -Y         -Z        FORCE-X      FORCE-Y      FORCE-Z         DISPL-X           DISPL-Y           DISPL-Z

  36        96.000     12.000      6.000      0.000        0.000        0.000      2.77829557E-02    9.73093158E-03  -1.05673514E-01
                                              0.000        0.000        0.000     -7.23076674E-03   -7.89237553E-03   1.44615335E-02
  37       108.000      0.000      9.000      0.000        0.000        0.000      0.                0.                0.
                                              0.000        0.000        0.000      0.                0.                0.
  38       108.000      0.000      6.000      0.000        0.000        0.000      0.                0.                0.
                                              0.000        0.000        0.000      0.                0.                0.
  39       108.000     12.000      3.000      0.000        0.000        0.000      0.                0.                0.
                                              0.000        0.000        0.000      0.                0.                0.
  40       108.000     12.000      6.000      0.000        0.000        0.000      0.                0.                0.
                                              0.000        0.000        0.000      0.                0.                0.

    NUMBER OF LAMINAE IN COMPOSITE ELEMENTS
 (  1)    3    3    3    3  (  2)    3    3   10   10  (  3)    6    3    3    3  (  4)    4    3   15   15  (  5)   10    3    3    3
 (  6)    7    3   16   16  (  7)    8    3    3    3  (  8)   10    3   17   17  (  9)   11    3    3    3  ( 10)   12    3   17   17
 ( 11)   13    3    3    3  ( 12)   15    3   18   18  ( 13)   28    3    3    3  ( 14)   17    3   15   15  ( 15)   32    3    3    3
 ( 16)   20    3   15   15  ( 17)   38    3    3    3  ( 18)   23    3   16   16  (

    TOTAL THICKNESS OF ELEMENTS

                 1          2          3          4          5          6          7          8          9          0

      0     .527E-01   .121E+00   .631E-01   .176E+00   .846E-01   .211E+00   .770E-01   .228E+00   .895E-01   .249E+00     10
      1     .103E+00   .266E+00   .179E+00   .246E+00   .202E+00   .260E+00   .229E+00   .290E+00   .888E-01   .888E-01     20
      2     .888E-01   .888E-01   .888E-01   .888E-01   .888E-01   .888E-01   .888E-01   .888E-01   .888E-01   .888E-01     30
      3     .888E-01   .888E-01   .888E-01   .888E-01   .888E-01   .888E-01   .117E-01   .117E-01   .117E-01   .117E-01     40
      4     .117E-01   .117E-01   .117E-01   .117E-01   .117E-01   .117E-01   .117E-01   .117E-01   .117E-01   .117E-01     50
      5     .117E-01   .117E-01   .117E-01   .117E-01 0.

 TIME USED IN SECONDS =   131.6260

    RELATIVE AREAS OF MEMBERS
     .181634    .417208    .217453    .605204    .291561    .726961    .265283    .785237    .308615    .857182
     .353761    .917472    .615373    .847694    .696893    .695519    .790056   1.000000    .306156    .306156
     .306156    .306156    .306156    .306156    .306156    .306156    .306156    .306156    .306156    .306156
     .306156    .306156    .306156    .306156    .306156    .306156    .040465    .040465    .040465    .040465
     .040465    .040465    .040465    .040465    .040465    .040465    .040465    .040465    .040465    .040465
     .040465    .040465    .040465    .040465

     .042083    .042087    .091203    .059022    .165311    .112037    .139033    .161351    .182365    .210235
     .227511    .259711    .483623    .299898    .570643    .349633    .663806    .396384

     .042083    .042083    .042083    .042083    .042083    .042083    .042083    .042083    .042083    .042083
     .042083    .042083    .042083    .042083    .042083    .042083    .042083    .042083

     .048734    .166521    .042083    .252050    .042083    .286421    .042083    .290901    .042083    .302431
     .042083    .307839    .042083    .252956    .042083    .251902    .042083    .280766

     .048734    .166521    .042083    .252050    .042083    .286421    .042083    .290901    .042083    .302431
     .042083    .307839    .042083    .252956    .042083    .251902    .042083    .280766
```

*****REACTIONS*****

JOINT	-X	-Y	-Z	FORCE-X	FORCE-Y	FORCE-Z	DISPL-X	DISPL-Y	DISPL-Z
37	108.000	0.000	9.000	72000.000	-2925.880	1000.000	0.	0.	0.
				.000	-.000	.000	0.	0.	0.
38	108.000	0.000	6.000	-72000.000	14793.688	1000.000	0.	0.	0.
				-9000.000	500.000	.000	0.	0.	0.
39	108.000	12.000	9.000	72000.000	2925.880	1000.000	0.	0.	0.
				-.000	.000	-.000	0.	0.	0.
40	108.000	12.000	6.000	-72000.000	-14793.688	1000.000	0.	0.	0.
				9000.000	500.000	-.000	0.	0.	0.

SUMMATION OF FORCES

APPLIED LOADS

LOAD COND	MX	MY	MZ	FX	FY	FZ
1	-.240000E+05	.113062E-04	-.144342E-05	.226279E-06	.486921E-08	-.400000E+04
2	.600000E+04	-.199336E-07	-.251407E-06	-.250387E-07	-.100000E+04	-.389991E-08

REACTIONS

LOAD COND	MX	MY	MZ	FX	FY	FZ
1	.240000E+05	-.134669E-04	.131130E-05	-.137836E-06	-.383709E-08	.400000E+04
2	-.600000E+04	-.451631E-07	-.200467E-06	.267755E-07	.100000E+04	.598811E-08

TIME USED IN SECONDS = 133.1600

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***********          X1NN0A4  //// END OF LIST ////
***********          X1NN0A4  //// END OF LIST ////
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